Myodocopid Ostracoda from the Late Permian of Greece and a Basic Classification for Paleozoic and Mesozoic Myodocopida

LOUIS S. KORNICKER
and
I.G. SOHN

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ABSTRACT

Kornicker, Louis S., and I.G. Sohn. Myodocopid Ostracoda from the Late Permian of Greece and a Basic Classification for Paleozoic and Mesozoic Myodocopida. *Smithsonian Contributions to Paleobiology,* number 91, 33 pages, 22 figures, 2000.—Four new genera and six new species are described from the top of the Episkopi Formation (Dorashamian) on the island of Hydra, Greece: *Cypridinelliforma rex* (new species), *Nodophilomedes phoenix* (new genus, new species), *Swainella bex* (new genus, new species), *Triadocypris pax* (new species), *Siveterella pax* (new genus, new species), *Siveterella flex* (new species), and *Sylvesterella* (new genus), based on specimens in the collection from Greece. Supplementary descriptions are presented of *Philomedes rankiniana* (Jones and Kirkby, 1867) and *Eocypridina radiata* (Jones and Kirkby, 1874).

A basic classification proposed for Paleozoic and Mesozoic Myodocopida includes a new suborder, three new superfamilies, and three new families.

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Myodocopid Ostracoda from the Late Permian of Greece and a Basic Classification for Paleozoic and Mesozoic Myodocopida

Louis S. Kornicker
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Introduction

Fossils of Permian myodocopid ostracodes are sparse in the geologic record (Kellett, 1935:132). The Permian ostracodes described herein are from the top of the Episkopi Formation (Dorashamian) (USNM localities 9260, 9262) on the island of Hydra, Greece (Sohn and Kornicker, 1998). This formation contains an excellent record of Late Permian life in the western Tethys Sea that may have lived in a calm, low-energy environment behind protecting algal reefs (Grant et al., 1991:493).

Carapaces of some of the Permian myodocopids in the collection appear to be morphologically more similar to those of Holocene taxa than do the carapaces of previously described Silurian to Carboniferous myodocopids. Because of this, we expanded our study of the Permian myodocopids from Greece to include a basic classification for some Paleozoic and Mesozoic myodocopids.

METHODS.—Discussions of methods, carapace measurements, samples, stratigraphy and paleoecology were described in Sohn and Kornicker (1998:1–2) and are not repeated herein. Length, height, or width measurements followed by an asterisk (*) indicate the measurement was based on the illustration; otherwise these measurements were taken using an optical micrometer and were based on the specimen.

Central adductor muscle scar patterns legitimately are used to discriminate taxa. Fossil myodocopids, however, rarely have preserved muscle scars; this presents a problem when attempting to relate specimens having preserved scars with those not having scars. Therefore, in taxonomic keys presented herein, we do not use muscle scar patterns. In order to make our classification of greater use to taxonomists attempting to identify unknowns, some taxa that we were unable to separate even broadly in a key have been synonymized.

DISPOSITION OF SPECIMENS.—Permian specimens have been deposited in the Department of Paleobiology, National Museum of Natural History (NMNH), Smithsonian Institution (under the acronym USNM for the former United States National Museum, which collections are now housed in the NMNH).

ABBREVIATIONS.—The following abbreviations are used in legends and text.

av	anterior view
dv	dorsal view
H	height
iv	inside view
L	length
LV	left valve
lv	lateral view
pv	posterior view
RV	right valve
vv	ventral view
W	width
*	shell measurement based on micrograph

ACKNOWLEDGMENTS.—The samples were collected by Richard E. Grant (NMNH, deceased) and Rex A. Doescher (NMNH). The process of leaching was headed by Doescher. The scanning electron micrographs are by W.R. Brown (NMNH). We thank Elizabeth Harrison-Nelson (NMNH) for general assistance, Molly Ryan (NMNH) for lettering plates, and Jack Korytowski (Smithsonian Institution Press) for final editing and preparation of the manuscript for publication.

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Classification

The new suborder Paleomyodocopina is proposed herein for taxa having a subcentral node on each valve. The known range of the Paleomyodocopina is Devonian to Permian, whereas the known range of the Myodocopina is Silurian to Recent. The suborders are assumed to have a common ancestry. The absence of post-Paleozoic Paleomyodocopina is interpreted herein as indicating that the suborder became extinct at the end of the Permian.

In an attempt to relate the extant and fossil Myodocopina, fossil Myodocopina are subdivided herein into the same three superfamilies comprising the Holocene Myodocopina: Cypridinacea, Sarsiellacea, and Cylindroleberidacea (Kornicker, 1986a, fig. 113). We have attempted herein to discriminate fossil superfamilies by selecting characters on the carapaces of the fossils that hold for most species in extant superfamilies. The fossil Myodocopina are referred to a particular Holocene superfamily on the basis of similarities in their carapace morphology. Unfortunately, within extant Myodocopina, which are classified mainly on the basis of appendage morphology, the carapaces of species within each superfamily have a wide range of shapes, ornamentation, and adductor muscle attachment scar patterns, which to some extent overlap between the superfamilies. Because of this, many fossils cannot be placed with certainty into a particular superfamily simply on the basis of carapace morphology, yet, with rare exceptions, this is all that is available. Errors in classification caused by the overlap of characters is a common problem in discriminating taxa.

Except for the presence of a subcentral node, the carapaces of many taxa referred to the Paleomyodocopina resemble those of fossil Myodocopina; we interpret the similarities to be parallelism. Nevertheless, in an attempt to relate fossil Myodocopina and Paleomyodocopina, we have assumed that carapace similarities between the taxa of each suborder are meaningful, possibly due to similarities in behavior and/or ecological requirements. The Paleomyodocopina are subdivided herein into three superfamilies, each having similarities with a superfamily in the Myodocopina (Table 1).

Our proposed classification includes mainly fossils whose similarity with extant taxa permitted the assumption that they are related. Many Paleozoic taxa that, in our opinion, do not closely resemble extant forms, have been previously referred to the Myodocopina (Siveter et al., 1987; Siveter and Vannier, 1990, fig. 16). Examples of such tax include *Rhombina* Jones and Kirkby, 1874 (*R. hibernica* Jones and Kirkby, 1874, and *R. belgica* Jones and Kirkby, 1874), *Bolbozoe* Barrande, 1872, and *Entomozoe* Pribyl, 1950. Our omission of such taxa from the proposed classification is not intended to infer that they are not Myodocopina, rather, the consideration of those taxa is outside the scope of the present effort. We offer the present classification as a base to which other taxa may be added.

TABLE 1.—Equivalent[1] superfamilies[2] and families in the Paleomyodocopina and the Myodocopina.

PALEOMYODOCOPINA	MYODOCOPINA
CYPRIDINELLIFORMACEA Cypridinelliformidae	CYPRIDINACEA Cypridinidae
NODOPHILOMEDACEA Nodophilomedidae	SARSIELLACEA Philomedidae
SWAINELLACEA Swainellidae	CYLINDROLEBERIDACEA Cylindroleberididae

[1]The nontaxonomic term equivalent as used herein identifies taxa within the two suborders having similarities in carapace morphology.

[2]The ending "-oidea" is usually preferred for superfamilies by Zoologists, and the ending "-acea" by Paleontologists (Sohn, 1984). Recommendation 29A in the International Code of Zoological Nomenclature (1985:55) recommended "that the suffix -OIDEA be added to the stem for the name of a superfamily." We have used "acea" in the present paleontological paper to conform with other similar papers.

Superorder MYODOCOPA Sars, 1866

COMPOSITION.—The superorder Myodocopa includes the orders Myodocopida and Halocyprida (Kornicker and Sohn, 1976:3, fig. 2). The Halocyprida includes the suborders Cladocopina and Halocypridina. Whatley et al. (1993:350) included in the order Myodocopida the suborders Myodocopina, Halocypridina, and Cladocopina. We herein include within the Myodocopida the new suborder Paleomyodocopina. Only the Myodocopida (sensu Kornicker and Sohn, 1976:3) and the equivalent Myodocopina (sensu Whatley et al., 1993: 350) are treated herein.

DIAGNOSIS.—Carapace extremely variable: rostrum and incisur developed or undeveloped; dorsal margin either arched or straight; valves strongly or weakly calcified, either smooth or ornamented with diverse processes. Appendages: with either 5 or 7 appendages (excluding copulatory organs); 2nd antennae adapted for swimming, and with exopod larger and with many more segments than endopod; 7th limb short, worm-like, or absent; paired furca flat, plate-like, sclerotized with rows of claws, and located posterior to anus. Male copulatory appendage single or double. Paired lateral compound eyes present or absent.

Most synapomorphies defining extant members are not shell characters, but the fossil shells included in the Myodocopa have shell characters like those of the extant Myodocopa.

RANGE.—Silurian to Holocene.

Order MYODOCOPIDA Sars, 1866

COMPOSITION.—The Myodocopida includes the suborders Myodocopina and Paleomyodocopina, new suborder.

DIAGNOSIS.—Carapaces generally larger and not as ovate as those of the Cladocopina; carapaces generally more strongly calcified and with more arcuate dorsal margins than those of the Halocypridina. Myodocopida differing from Cladocopina in having 7 rather than 5 limbs (excluding copulatory organ),

from Halocypridina in having a worm-like 7th limb, and from both taxa in the male having paired copulatory organs. Lateral eyes possibly present in Myodocopina but absent in Cladocopina and Halocypridina.

RANGE.—Paleomyodocopina: Devonian to Permian. Myodocopina: Silurian to Recent.

Key to Suborders of the Myodocopida

Carapace with subcentral node [node replaced by a backward-directed dorsal protuberance in the genus *Sulcuna*] . . . . . **PALEOMYODOCOPINA,** new suborder
Carapace without subcentral node . . . . . **MYODOCOPINA**

PALEOMYODOCOPINA, new suborder

COMPOSITION.—The Paleomyodocopina includes the superfamilies Cypridinelliformacea, Nodophilomedacea, and Swainellacea.

DIAGNOSIS.—Carapace with subcentral node replaced by backward-directed dorsal protuberance in genus *Sulcuna.* Nuchal furrow and rostrum either present or absent. Appendages unknown, but herein presumed similar to those of the Myodocopina.

RANGE.—Devonian to Permian.

Key to Superfamilies of the Paleomyodocopina

(Key includes characters of most members of each superfamily)

1. Tip of rostrum generally truncate . . . . . **NODOPHILOMEDACEA,** new superfamily
   Tip of rostrum generally rounded or pointed 2
2. Carapace circular in lateral view . . . . . **SWAINELLACEA,** new superfamily
   Carapace elliptical in lateral view . . . . . **CYPRIDINELLIFORMACEA,** new superfamily

CYPRIDINELLIFORMACEA, new superfamily

COMPOSITION.—The superfamily Cypridinelliformacea includes the families Cypridelliformidae and Cyprellidae.

DIAGNOSIS.—Carapace elliptical in lateral view, with smooth or irregular margin: posterior half of dorsal margin straight or convex; posterior of valve acuminate, terminating in acute or rounded caudal process; rostrum with rounded tip, and either down-curved, or with horizontal ventral margin; anterior edge of margin ventral to incisur either extending past tip of rostrum forming prow, or not extending past tip of rostrum; node present near dorsal margin anterior to midlength (node replaced by backward-directed dorsal protuberance in genus *Sulcuna*); nuchal furrow (median sulcus (Moore, 1961:Q53)) either present or absent. Carapace smooth or with either vertical or horizontal ribs. In inside medial view, posterior half of dorsal margin generally with straight oblique hinge line.

RANGE.—Carboniferous and Permian.

Key to Families of the Cypridinelliformacea

Carapace with vertical ribs . . . . . **CYPRELLIDAE**
Carapace without vertical ribs . . . . . **CYPRIDINELLIFORMIDAE,** new family

CYPRIDINELLIFORMIDAE, new family

COMPOSITION.—The family Cypridinelliformidae includes the genera *Cypridellina, Cypridella, Sulcuna,* and *Cypridinelliforma. Cyprisucella* Sanchez de Posada and Bless, 1971:203, which is close to *Cypridella,* also may be included in the Cypridinelliformidae, but this requires further study.

DIAGNOSIS.—In outside lateral view: posterior half of dorsal margin straight or convex; posterior of valve acuminate, terminating in acute or rounded caudal process; tip of rostrum rounded and with horizontal ventral margin; anterior edge of margin ventral to incisur either extending past tip of rostrum (*Sulcuna, Cypridellina*) forming prow, or not extending past tip of rostrum (*Cypridella, Cypridinelliforma*); node present near dorsal margin anterior to midlength; node either projecting perpendicular from valve, or projecting posteriorly (node replaced by backward-directed dorsal protuberance in the genus *Sulcuna*). Nuchal furrow either present (*Cypridella, Sulcuna*) or absent (*Cypridellina, Cypridinelliforma*). In inside medial view, posterior half of dorsal margin with straight oblique hinge line. In anterior view, ventral edge of rostrum either horizontal or close to horizontal.

RANGE.—Devonian to Permian.

Key to Genera of the Cypridinelliformidae

1. Carapace with nuchal furrow 2
   Carapace without nuchal furrow 3
2. Anteroventral prow extending past tip of rostrum ..... ***Sulcuna***
   Anteroventral prow not extending past tip of rostrum ..... ***Cypridella***
3. Anteroventral prow extending past tip of rostrum ..... ***Cypridellina***
   Anteroventral prow not extending past tip of rostrum ..... ***Cypridinelliforma***

Cypridella Koninck, 1841

TYPE SPECIES.—*Cypridella cruciata* Koninck, 1841. (The type species, *C. cruciata,* illustrated by Koninck (1841, fig. 11a–d) differs considerably from the illustration of *Cypridella* sp. by Sylvester-Bradley (1961, fig. 325:2a–d). The former is without a siphon, and the tubercles do not project backward.)

DIAGNOSIS.—Carapace with anteroventral margin generally not extending past tip of rostrum, with subcentral tubercle (backwardly directed on some species), and with curved nuchal furrow just posterior to tubercle; caudal siphon well developed or absent; other tubercles possibly present. Diagnosis in part from Sylvester-Bradley (1961:Q403, fig. 325:2a–d).

RANGE.—Upper Devonian to Lower Permian (Whatley et al., 1993:350).

Sulcuna Jones and Kirkby, 1874

TYPE SPECIES.—*Sulcuna lepus* Jones, Kirkby, and Brady, 1874, subsequent designation by Bassler and Kellett, 1934.

DIAGNOSIS.—Subcentral node replaced by backward-directed dorsal protuberance and defined posteriorly by shallow nuchal furrow; anteroventral margin projecting slightly past tip of rostrum (from Sylvester-Bradley, 1961:Q403–Q404, fig. 325:4).

RANGE.—Carboniferous, Europe (Sylvester-Bradley, 1961: Q403).

DISCUSSION.—Siveter and Vannier (1990:48) included the genus *Sulcuna* in the family Bolbozoidea. Because of the prominent rostrum of *Sulcuna lepus,* the type species, we prefer to include the genus in the Cypridinelliformidae.

Cypridellina Jones and Kirkby, 1874

TYPE SPECIES.—*Cypridellina clausa* Jones and Kirkby, 1874, subsequent designation by Bassler and Kellett, 1934.

DIAGNOSIS.—Subcentral node slightly above center of each valve; anteroventral margin extending well past tip of rostrum; without nuchal furrow (from Sylvester-Bradley, 1961:Q403–Q404, fig. 325:3).

RANGE.—Carboniferous, Europe (Sylvester-Bradley, 1961: Q403).

Cypridinelliforma Bless, 1971

TYPE SPECIES.—*Cypridinelliforma emmaensis* Bless, 1971.

DIAGNOSIS.—From Bless (1971:22): Carapace elongate with projecting rostrum forming an acute angle in lateral view; ventral edge of rostrum horizontal and fairly straight in well-preserved specimens. Complete carapace slightly narrower than high. Dorsal margin viewed laterally with anterior ⅜ evenly rounded and posterior ⅝ rounded, or almost straight except for slight concavity near posterior end. Concavity coincides with a round hole (siphon) with posterodorsal orientation. Ventral edge of carapace in lateral view slightly convex in anterior ⅔, and more convex and upsweeping in posterior ⅓. Anteroventral margin not reaching tip of rostrum in some specimens, and just reaching tip of rostrum in others. Each valve with rounded or tapered node just dorsal to valve midheight and anterior to valve midlength. Lateral surface with ridges on well-preserved specimens. Straight, slightly indented, oblique hinge present along posterior half of dorsal margin. Posterior end of hinge terminating in siphon. Siphon not evident on all specimens. Hinge teeth and nuchal furrow absent. Broad triangular infold present in posterior end of valve ventral to siphon. Adductor muscle attachment scars unknown. Known length range 1.45–2.29 mm.

RANGE.—Upper Carboniferous (Bless, 1971); Permian (herein).

COMPARISONS.—The carapace of *Cypridinelliforma* differs from *Cypridellina* and *Sulcuna* in that the anteroventral prow does not extend past the tip of the rostrum; it differs from *Cypridella* and *Sulcuna* in not having a nuchal furrow.

Cypridinelliforma rex, new species

FIGURES 1–7

ETYMOLOGY.—From the Latin *rex* (king).

HOLOTYPE.—USNM 496703, complete carapace.

TYPE LOCALITY.—USNM 496703 locality 9260: Greece 1, 21 Aug 1968, uppermost brachiopod zone in Episkopi section B, Episkopi Formation, Barmari Group, Late Permian (Dorashamian), Hydra, Greece (Grant et al., 1991:482, 495).

PARATYPES.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1974: USNM 496717, LV; USNM 496718, RV; USNM

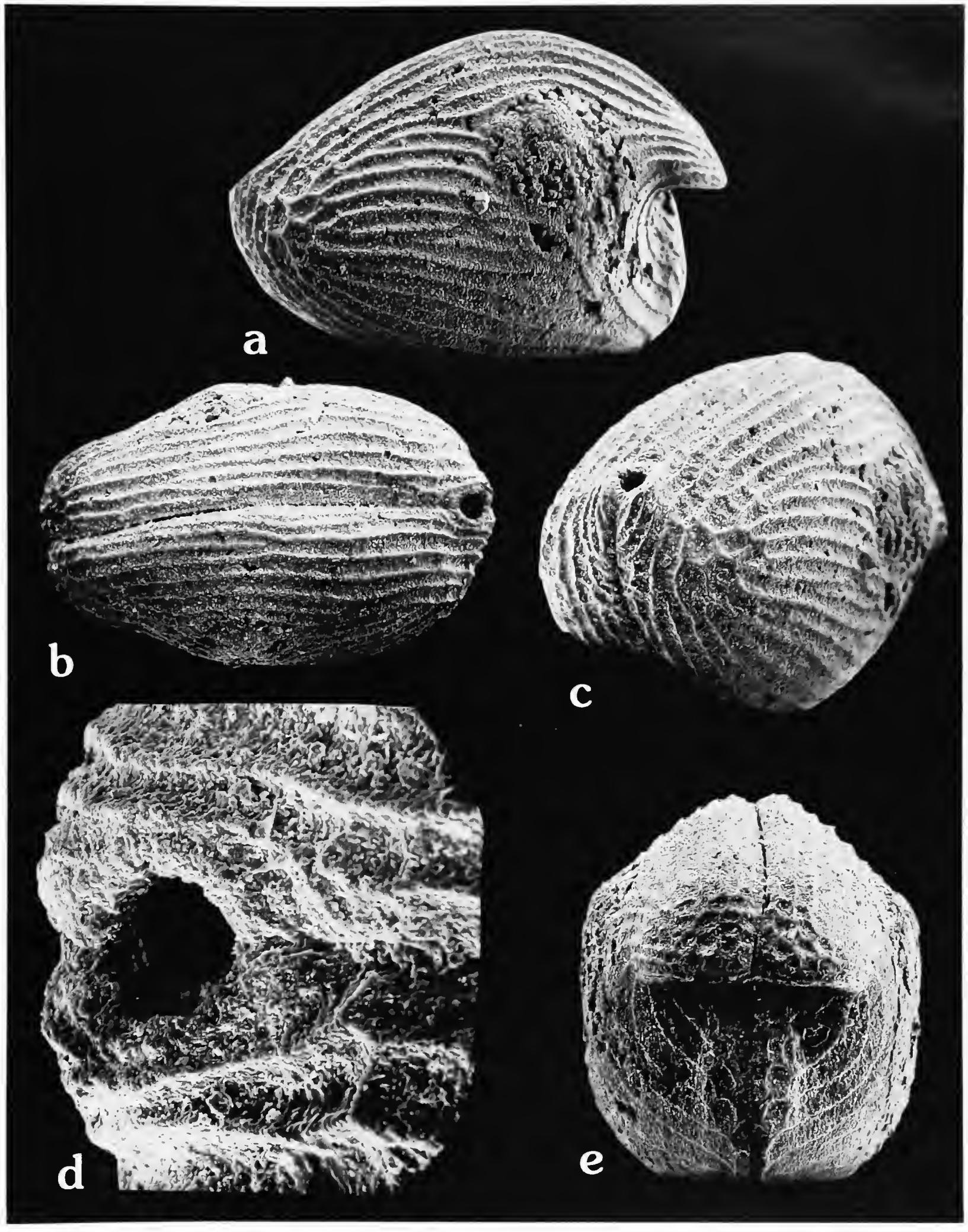


FIGURE 1.—*Cypridinelliforma rex*, new species, holotype, USNM 496703, complete carapace, length 1.78 mm: *a*, lv, × 56; *b*, dv, × 50; *c*, oblique view, × 63; *d*, detail of siphon in *b*, × 280; *e*, av, × 65. (Original magnifications of micrographs reduced to 88% for publication.)

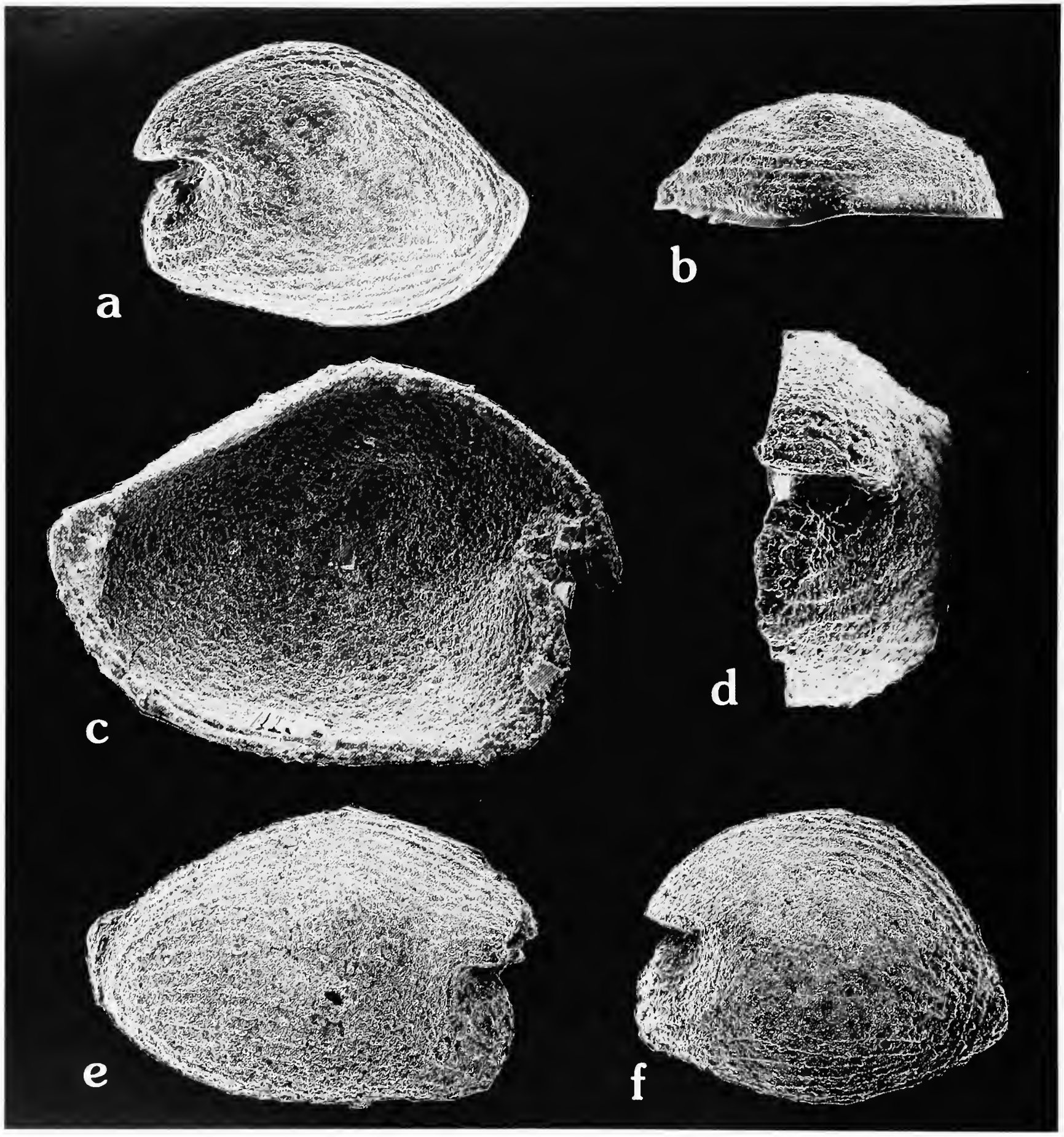


FIGURE 2.—*Cypridinelliforma rex*, new species. Paratype, USNM 496727, LV, length 1.50* mm: *a*, lv, × 46; *b*, av?, × 42; *c*, iv, × 75; *d*, av. USNM 496704, RV, length 1.85* mm: *e*, lv, × 41. USNM 496705, LV, length 1.45 mm: *f*, lv, × 41.

496719, LV; USNM 496720, LV. USNM locality 9262, Hydra, Greece 2, 23 Aug 1968: USNM 496704 (broken after SEM), RV; USNM 496705, LV; USNM 496706, RV; USNM 496707 (broken), RV; USNM 496727 (lost), LV.

DISTRIBUTION.—Permian: USNM localities 9260 and 9262, Hydra, Greece.

DESCRIPTION (Figures 1–7).—Carapace elongate with projecting rostrum forming an acute angle in lateral view (Figures

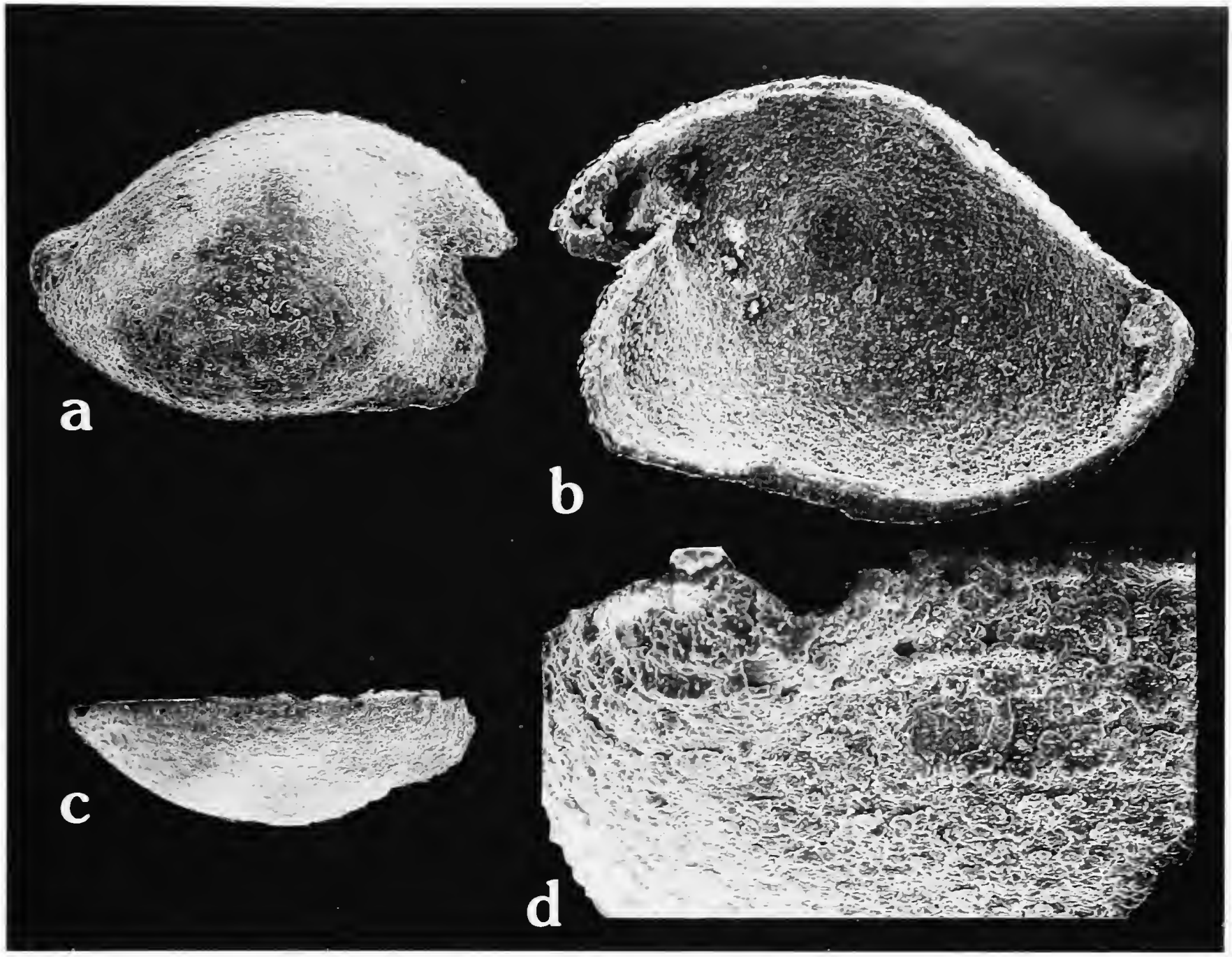


FIGURE 3.—*Cypridinelliforma rex*, new species, paratype, USNM 496706, RV, length 1.47 mm: *a*, lv, × 43; *b*, iv, × 65; *c*, dv, anterior to right, × 40; *d*, view of siphon in *c*, × 175. (Original magnifications of micrographs reduced to 99% for publication.)

1*a*, 2*a*,*f*, 4*a*, 5*a*, 6*a*,*b*, 7*a*); ventral edge of rostrum horizontal and fairly straight in well-preserved specimens (Figures 1*a*,*e*, 2*a*,*d*,*f*, 4, 5*a*,*d*, 7). (The hook-like rostrum on one specimen (Figure 6*a*,*b*) tentatively is interpreted as an artifact caused by abrasion.) Complete carapace slightly narrower than high (Figure 1*e*). Dorsal margin viewed laterally with anterior ⅜ evenly rounded and posterior ⅝ almost straight, except for slight concavity near posterior end (Figure 1*a*). Concavity coinciding with a round hole (siphon) with posterodorsal orientation (Figures 1*b*–*d*, 2*c*, 3*b*–*d*). Siphon not observed on all specimens (Figures 4–7) and possibly lacking. Ventral edge of carapace in lateral view slightly convex in anterior ⅔, and more convex and upsweeping in posterior ⅓ (Figures 1*a*, 2*a*,*c*,*e*,*f*). Anteroventral margin not reaching tip of rostrum in some specimens (Figure 1*a*), and just reaching tip of rostrum in others (Figure 2*f*).

Ornamentation: Each valve with rounded or tapered node just dorsal to valve midheight and anterior to valve midlength (Figures 1*a*–*c*, 2*a*,*b*, 3*a*, 4, 5, 6*c*, 7). Node reflected by concavity on inner side of valve (Figures 2*c*, 3*b*, 6*a*,*b*, 7*a*). Node worn off on some specimens (Figure 2*e*,*f*), and when broken off appearing as a hole (Figure 7*a*). Anterior surface ventral to rostrum with concentric ridges (seen best in anterior view, Figures 1*e*, 2*d*). Three or 4 ribs extending from anterior end of rostrum around periphery of valve and terminating in anteroventral part of valve in vicinity of anterior concentric ridges (Figures 1*a*–*c*, 2*a*,*b*,*d*–*f*); 10 or 11 straight or slightly convex longitudinal ribs present within area of peripheral ribs (Figure 1*a*); 2 ribs just dorsal to round node follow contour of dorsal edge of process

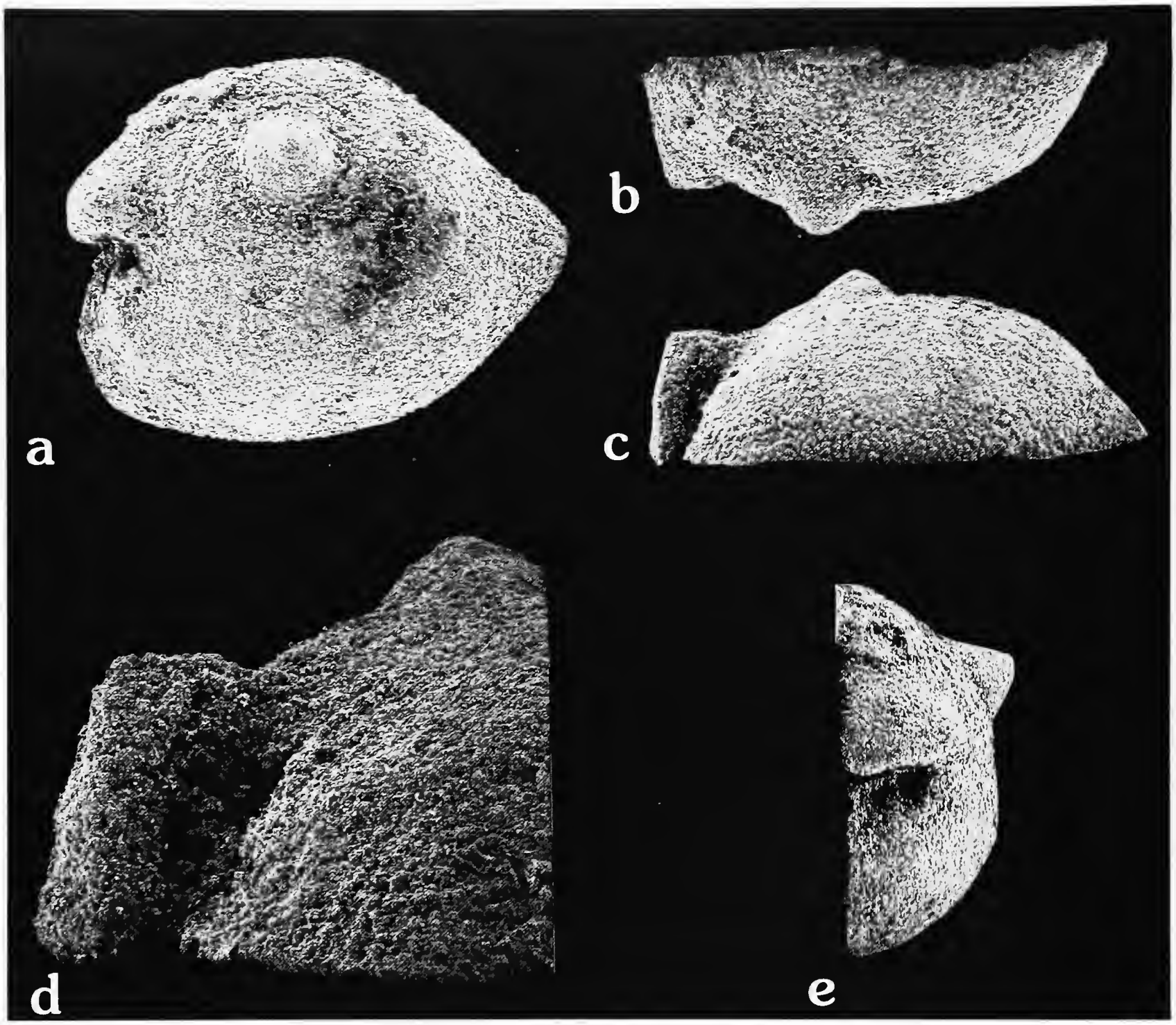


FIGURE 4.—*Cypridinelliforma rex,* new species, paratype, USNM 496717, LV, length 1.69 mm: *a,* lv, × 35; *b,* dv, anterior to left, × 35; *c,* vv, anterior to left, × 35; *d,* vv of rostrum, × 89.5; *e,* av, × 35.2.

(Figure 1*a–c*). Cross riblets connect ribs near posterior end of valves to form reticules (Figure 1*a,c*). Weakly developed reticules also present on rostrum near tip (Figure 1*e*). Ribs interpreted to be worn off on many specimens (Figures 3*a,c,d,* 4, 5, 6*c*).

Hinge: Straight, slightly indented, oblique hinge present along posterior half of dorsal margin (Figures 2*c,* 3*b,* 6*a*). Posterior end of hinge terminating in siphon (Figures 1*b–d,* 2*c,* 3*b–d*). Hinge teeth absent.

Infold: Broad triangular infold present in posterior end of valve ventral to siphon (Figures 2*c,* 6*a,d*).

Central Adductor Muscle Scars: Unknown.

Carapace Size (in mm): Holotype, USNM 496703, complete carapace, L=1.78, H=1.23, W=1.04. Paratypes: USNM 496704 (broken), RV, L=1.85*, H=1.22*; USNM 496705, LV, L=1.45, H=1.15; USNM 496706, RV, L=1.47, H=1.00; USNM 496717, LV, L=1.69, H=1.26; USNM 496718, RV, L=1.90, H=1.43; USNM 496719, LV, L=1.74, H=1.26; USNM 496720, LV, L=1.64, H=1.32; USNM 496727 (lost), LV, L=1.50*, H=0.86*. Length range: 1.45–1.90.

Variability: Ribs are well developed in the holotype (Figure 1*a*) but are less well developed (Figure 2*a*) or absent (Figure 3*a*) in most specimens. We interpret this to be the result of

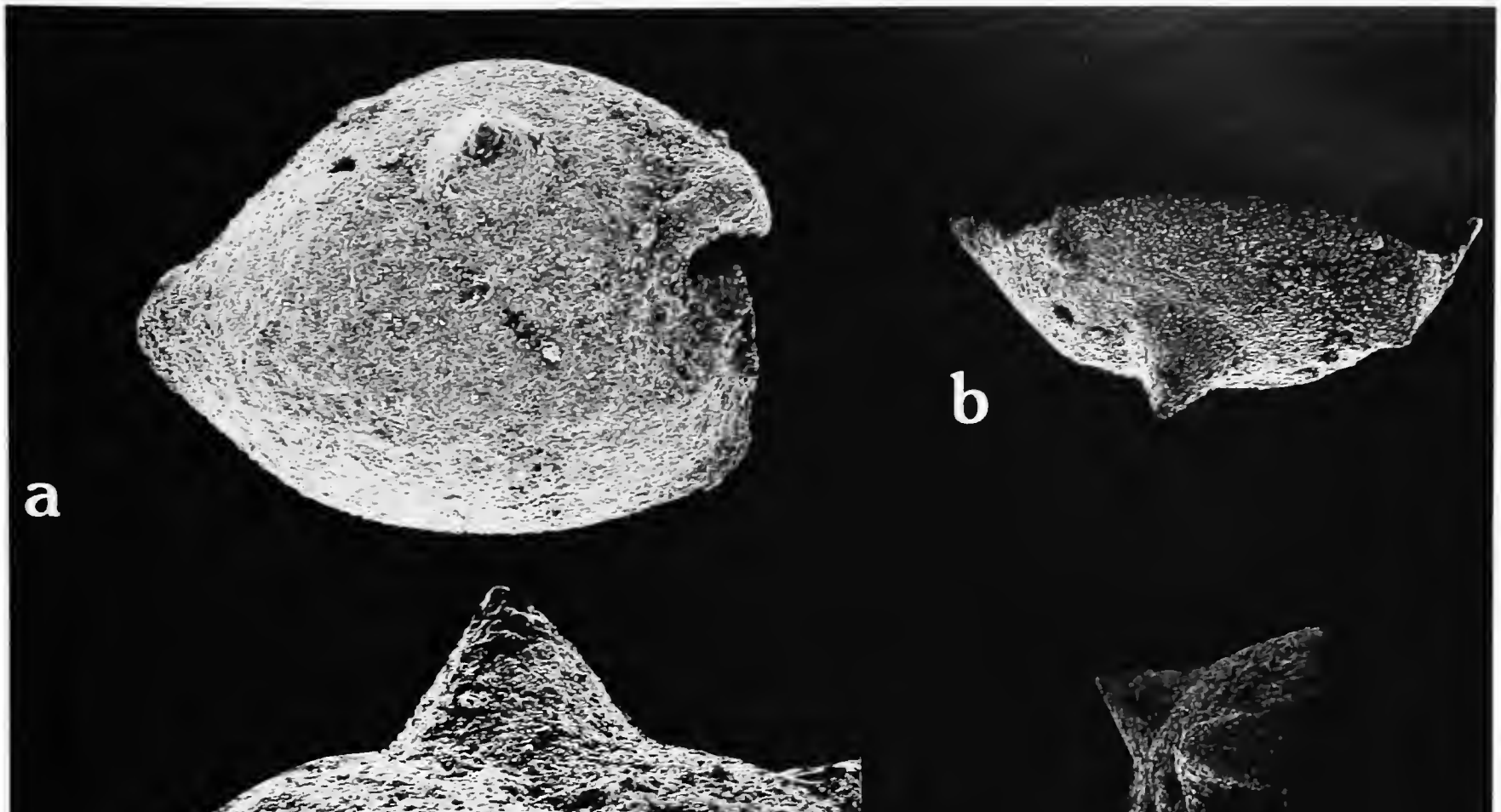


FIGURE 5.—*Cypridinelliforma rex*, new species, paratype, USNM 496718, RV, length 1.90 mm: *a*, lv, × 45; *b*, dv, anterior to right, × 35; *c*, posteroventral view of tapered process at maximum extension, × 75; *d*, av, × 35. (Original magnifications of micrographs reduced to 89% for publication.)

differential preservation. Cross riblets forming reticulations in the posterior end of the carapace are visible only on the holotype (Figure 1*a,c*). We interpret this to be either the result of differential preservation or intraspecific variability. We do not exclude, however, the possibility that the differences in ornamentation among the specimens studied are the result of more than one species being present.

COMPARISONS.—The new species differs from *Cypridinelliforma emmaensis* in having a straighter posterodorsal margin.

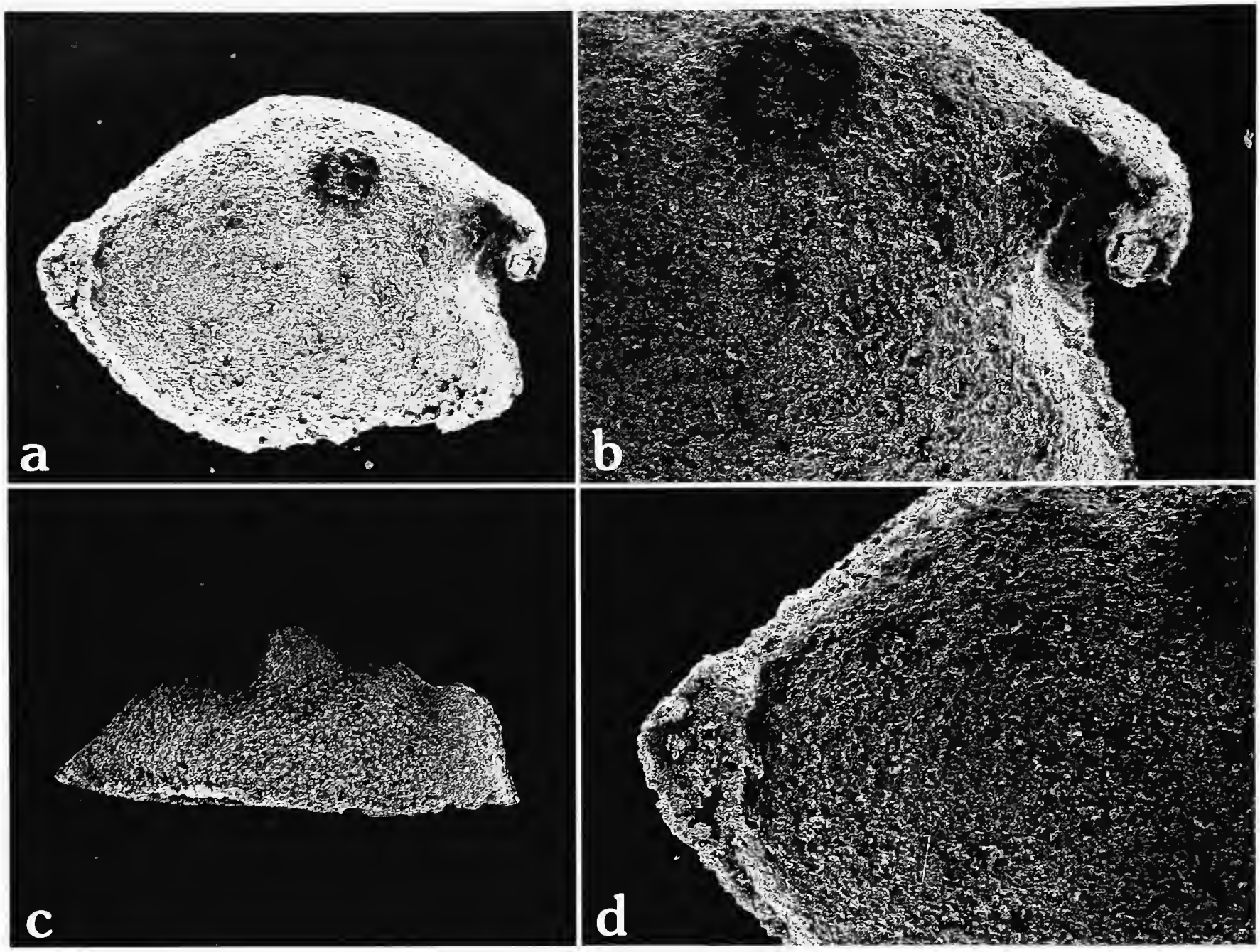


FIGURE 6.—*Cypridinelliforma rex,* new species, paratype, USNM 496719, LV, length 1.74 mm: *a,* iv, × 35; *b,* detail of anterior, from *a,* × 70; *c,* dv, anterior to right, × 33.4; *d,* detail of posterior, from *a,* × 70. (Original magnifications of micrographs reduced to 89% for publication.)

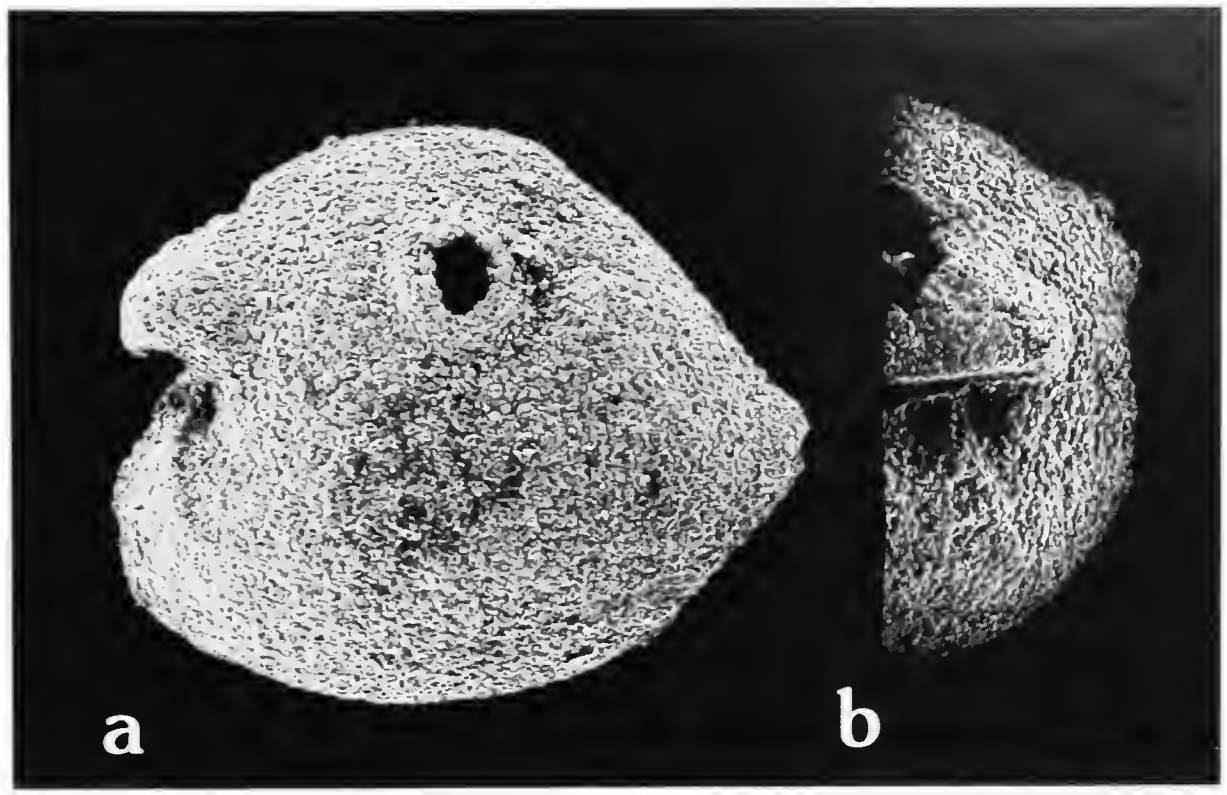


FIGURE 7.—*Cypridinelliforma rex,* new species, paratype, USNM 496720, LV, length 1.64 mm: *a,* lv, × 35.2; *b,* av, × 35.

CYPRELLIDAE Sylvester-Bradley, 1961

COMPOSITION.—The family includes only the genus *Cyprella.*

DIAGNOSIS.—"Carapace annulate; rostrum down-curved; incisure horizontal; posterior produced into caudal siphon" (Sylvester-Bradley, 1961:Q402). Narrow nuchal furrow behind tubercle.

RANGE.—Lower Carboniferous (Whatley et al., 1993:350).

NODOPHILOMEDACEA, new superfamily

COMPOSITION.—The Nodophilomedacea includes the new family Nodophilomedidae.

DIAGNOSIS.—Carapace oval in lateral view, with deep incisur and square-tipped rostrum at valve midheight. Posterior margin of valve extending posteriorly to form distinct angle at midheight (Nodophilomedidae). Surface smooth or faintly reticulate. Node better developed in some specimens than in others, and possibly absent (node absence presumed herein to be the result of wear, but possibly node never present).

RANGE.—Permian.

NODOPHILOMEDIDAE, new family

COMPOSITION.—The Nodophilomedidae includes the new genus *Nodophilomedes.*

DIAGNOSIS.—Carapace oval in lateral view with deep incisur and square-tipped rostrum at valve midheight. Posterior margin of valve extending posteriorly to form distinct angle at midheight. Posteroventral margin more oblique than antero-ventral margin; posterodorsal margin either straight or less rounded than anterodorsal margin. Each valve rounded in dorsal view and with width about ½ length; anterior half in dorsal view more acuminate than posterior half on some specimens, but similar in other specimens. In anterior view valve broader in ventral half. Surface smooth except for rounded node near midlength dorsal to midheight. Node better developed in some specimens than in others, and possibly absent (the latter presumed to be the result of wear, but possibly never present). Straight posterodorsal margin on some specimens suggesting hinge located there.

RANGE.—Permian.

Nodophilomedes, new genus

ETYMOLOGY.—From the Latin *nodus* (swelling) plus *Philomedes.*

TYPE SPECIES.—*Nodophilomedes phoenix.*

DIAGNOSIS.—Same as for family.

RANGE.—Permian.

Nodophilomedes phoenix, new species

FIGURES 8, 9

ETYMOLOGY.—From the Latin *phoenix* (purple-red).

HOLOTYPE.—USNM 496708, LV.

TYPE LOCALITY.—USNM locality 9262, Hydra, Greece, 23 Aug 1968, about 1 km nearly due E of the village of Episkopi (S side of island), down steep trail to about 25 m elevation near shrine called Aya Hohannis, relatively flat area where Permian beds make terraces. Collected from 4 ft. (1.2 m) bed. R.E. Grant, collector, 23 Aug 1968.

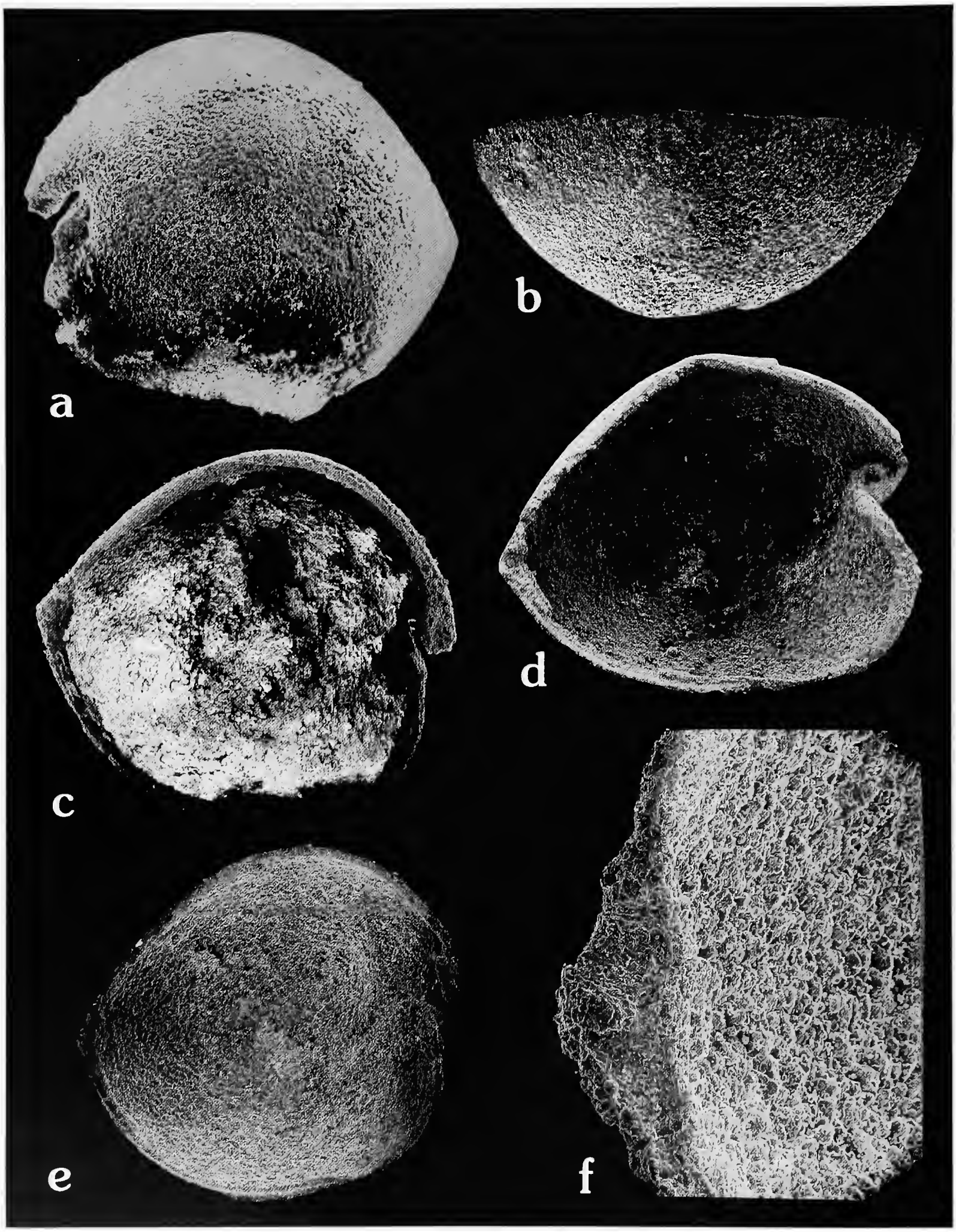


FIGURE 8.—*Nodophilomedes phoenix,* new species. Paratype, USNM 496709, LV, length 2.51* mm: *a,* lv, × 38; *b,* dv, × 37; *c,* iv, × 32. Holotype, USNM 496708, LV, length 2.83 mm: *d,* iv, × 30. Paratype, USNM 496735, LV, length ~2.65* mm: *e,* iv, × 30; *f,* iv, posterior tip, from *e,* × 150. (Original magnification reduced to 84% for publication.)

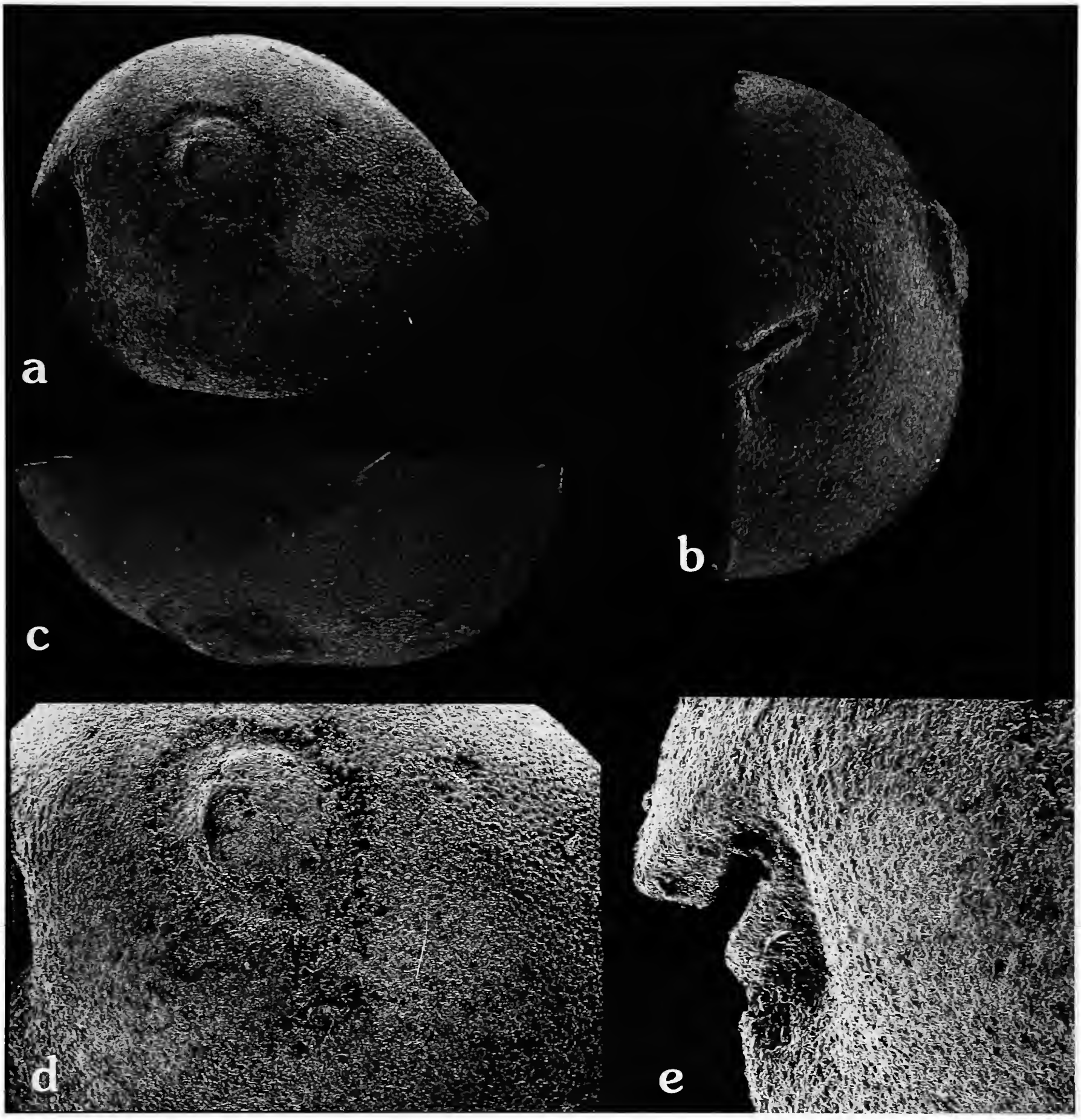


FIGURE 9.—*Nodophilomedes phoenix*, new species, paratype, USNM 496726, LV, length 3.8 mm: *a*, lv, × 20.6; *b*, av, × 24.6; *c*, dv, × 21; *d*, detail of rounded process, from *a*, × 36; *e*, detail of rostrum, from *a*, × 60. (Original magnifications of micrographs reduced to 86% for publication.)

PARATYPES.—USNM locality 9262: USNM 496709 (lost), LV; USNM 496726, LV; USNM 496735 (lost), LV.

DISTRIBUTION.—Permian: USNM locality 9262, Hydra, Greece.

DESCRIPTION (Figures 8, 9).—Carapace oval in lateral view, with deep incisur and square-tipped rostrum at valve midheight (Figures 8*a,c*, 9*a,e*). Posterior margin of valve extending posteriorly to form distinct angle at midheight. Posteroventral mar-

gin more oblique than anteroventral margin; posterodorsal margin either straight or less rounded than anterodorsal margin (Figures 8*a,c–e,* 9*a*). Dorsal outline rounded; width approximately ½ length (Figure 9*c,b*); anterior half in dorsal view more acuminate than posterior half on some specimens (Figure 9*c*), but similar in other specimens (Figure 8*b*). In anterior view, valve broader in ventral half (Figure 9*b*). Notch on anteroventral margin just ventral to incisur visible in Figure 9*a,e* is interpreted to be an artifact.

Ornamentation: Surface smooth except for rounded node near midlength dorsal to midheight. Node better developed in some specimens (Figure 9*a–d*) than in others, and possibly absent (the latter presumed to be the result of wear (Figure 8*a,b*), but possibly never present (Figure 8*e* is an inside view of valve without depression that would indicate presence of outer node)).

Hinge: Straight posterodorsal margin on some specimens suggests hinge located there (Figure 8*d,e*).

Infold: Small infold evident in and ventral to posterior angle (Figure 8*d–f*). Small siphon possibly present immediately dorsal to posterior angle (Figure 8*f*).

Central Adductor Muscle Scars: None observed.

Carapace Size (in mm): Holotype, USNM 496708, LV, L= 2.83, H=2.23. Paratypes: USNM 496709 (lost), LV, L=2.51*, H=2.24*, W=1.11*; USNM 496735 (lost), LV, L=~2.65*; USNM 496726, LV, L=3.8, H=3.0. Length range, 2.51–3.8.

SWAINELLACEA, new superfamily

COMPOSITION.—The Swainellacea includes the family Swainellidae, new family.

DIAGNOSIS.—Carapace circular in lateral view with tapered rostrum and broad incisur. Valve width about ½ valve length. Central part of valve fairly flat. Each valve with anterodorsal, large, rounded node just dorsal to midheight, node appearing as depression on inside of valve. Outer surface of valve with round pits. Pits less well developed on some valves. Surface of valves with several low nodes.

RANGE.—Permian.

REMARKS.—According to Siveter et al. (1987:793), "Cypridinid" gen. et sp. nov. A (Siveter et al., 1987)," which resembles *Swainella bex,* new species, lacks an anterodorsal node. The lack of the node places that genus in the Myodocopina, rather than in the Paleomyodocopina.

SWAINELLIDAE, new family

TYPE SPECIES.—*Swainella bex,* new species.

COMPOSITION.—The Swainellidae includes the genus *Swainella.*

DIAGNOSIS.—Same as for superfamily.

RANGE.—Permian.

Swainella, new genus

ETYMOLOGY.—Named in honor of Frederick M. Swain, ostracodologist.

TYPE SPECIES.—*Swainella bex,* new species.

DIAGNOSIS.—Same as for family. Known length range, 1.27–1.59 mm.

RANGE.—Permian.

Swainella bex, new species

FIGURES 10–13

ETYMOLOGY.—From the Greek *bex* (cough).

HOLOTYPE.—USNM 496725, RV.

TYPE LOCALITY.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1974.

PARATYPES.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1974: USNM 496712, LV; USNM 496713, RV; USNM 496724, LV; USNM 496723, RV.

DISTRIBUTION.—Permian: USNM locality 9260, Hydra, Greece.

DESCRIPTION.—Carapace oval in lateral view with tapered rostrum and broad incisur (Figures 10*a–c,* 11*b,c,* 12*a,b*). Valve width about ½ valve length (Figures 10*b,d,e,* 11*b,c,* 12*b*). Central part of valve fairly flat (Figures 10*b,d,e,* 11*a,b,* 12*b,c*).

Ornamentation: Each valve with anterodorsal, large, rounded node just dorsal to midheight (Figures 10*a,b,* 11, 12*a,* 13*a,c*); node appearing as depression on inside of valve (Figures 10*c,* 13*d* (faint)). Outer surface of valve with round pits (Figures 12*a,c,* 13*a–c,e,f*). Pits less well developed on some valves (Figures 10*a,* 11*a*). Surface of valves with low nodes (Figures 10*a,b,d,e,* 11*b,c,* 12*a,c,* 13*a,c*).

Hinge: None evident (Figures 10*c,* 13*d*).

Infold: Not preserved (Figures 10*c,* 13*d*).

Carapace Size (in mm): Holotype, USNM 496725, RV, L= 1.59, H=1.37. Paratypes: USNM 496713, RV, L=1.33, H=1.16; USNM 496712, LV, L=1.39, H=1.18; USNM 496723, RV, L=1.27, H=1.08; USNM 496724, LV, L=1.41, H=1.13. Length range 1.27–1.59.

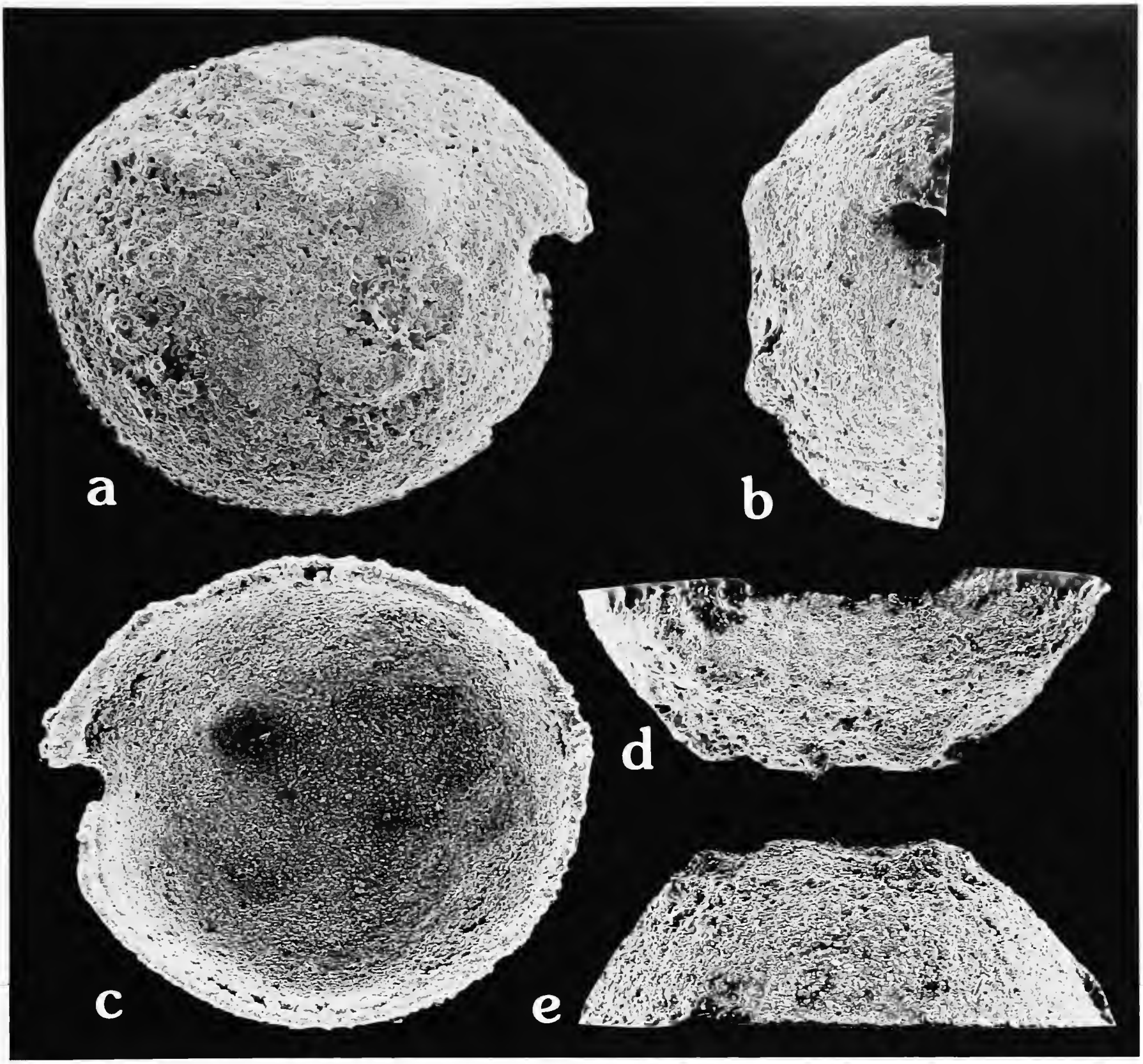


FIGURE 10.—*Swainella bex*, new species, paratype, USNM 496723, RV, length 1.27 mm: *a*, lv, × 75; *b*, av, × 75; *c*, iv, × 75; *d,e*, dv and vv, respectively, × 75. (Original magnifications of micrographs reduced to 98% for publication.)

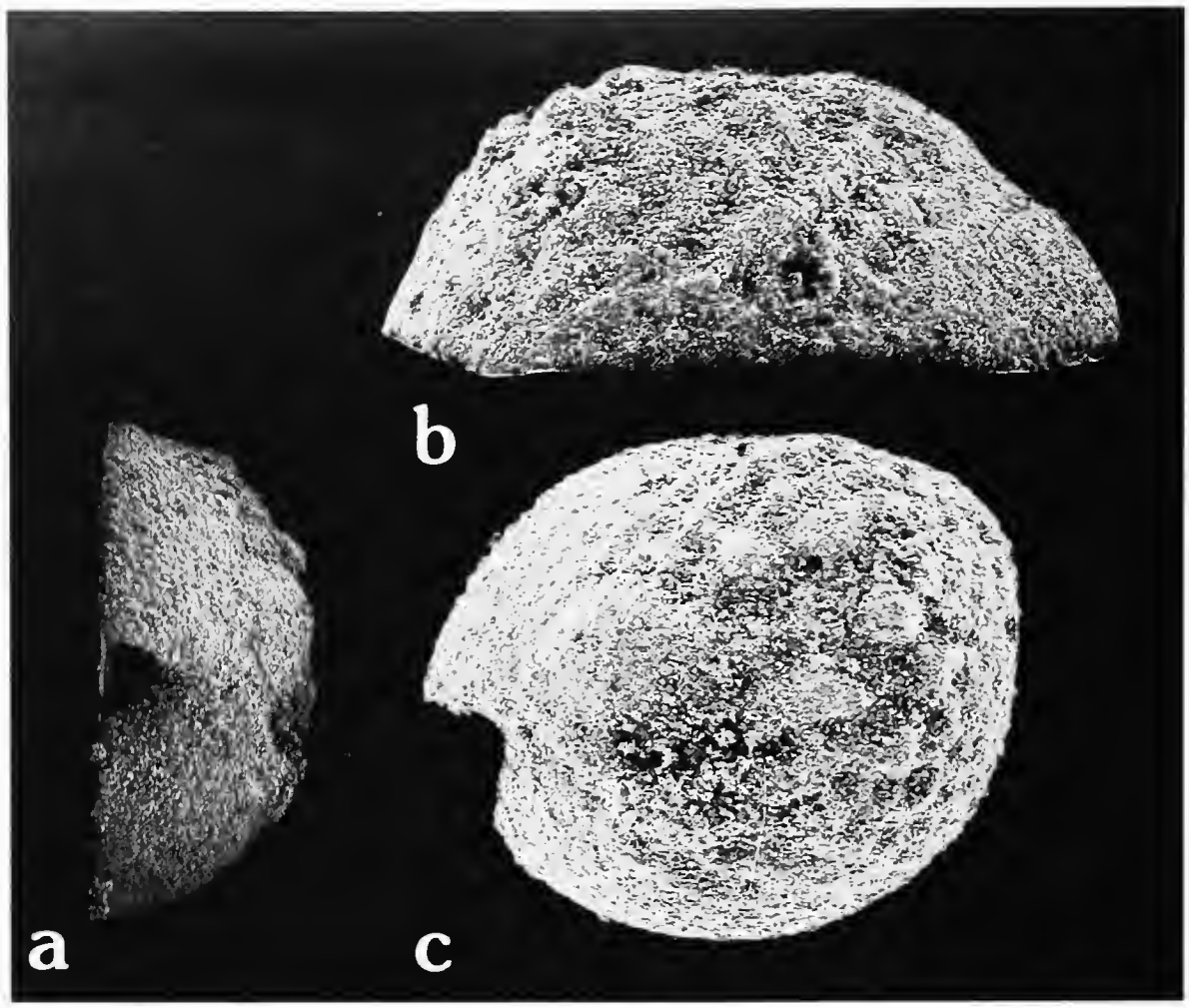


FIGURE 11.—*Swainella bex,* new species, paratype, USNM 496724, LV, length 1.41 mm: *a,* av, × 47.8; *b,* dv, ×34.6; *c,* lv, × 34.8.

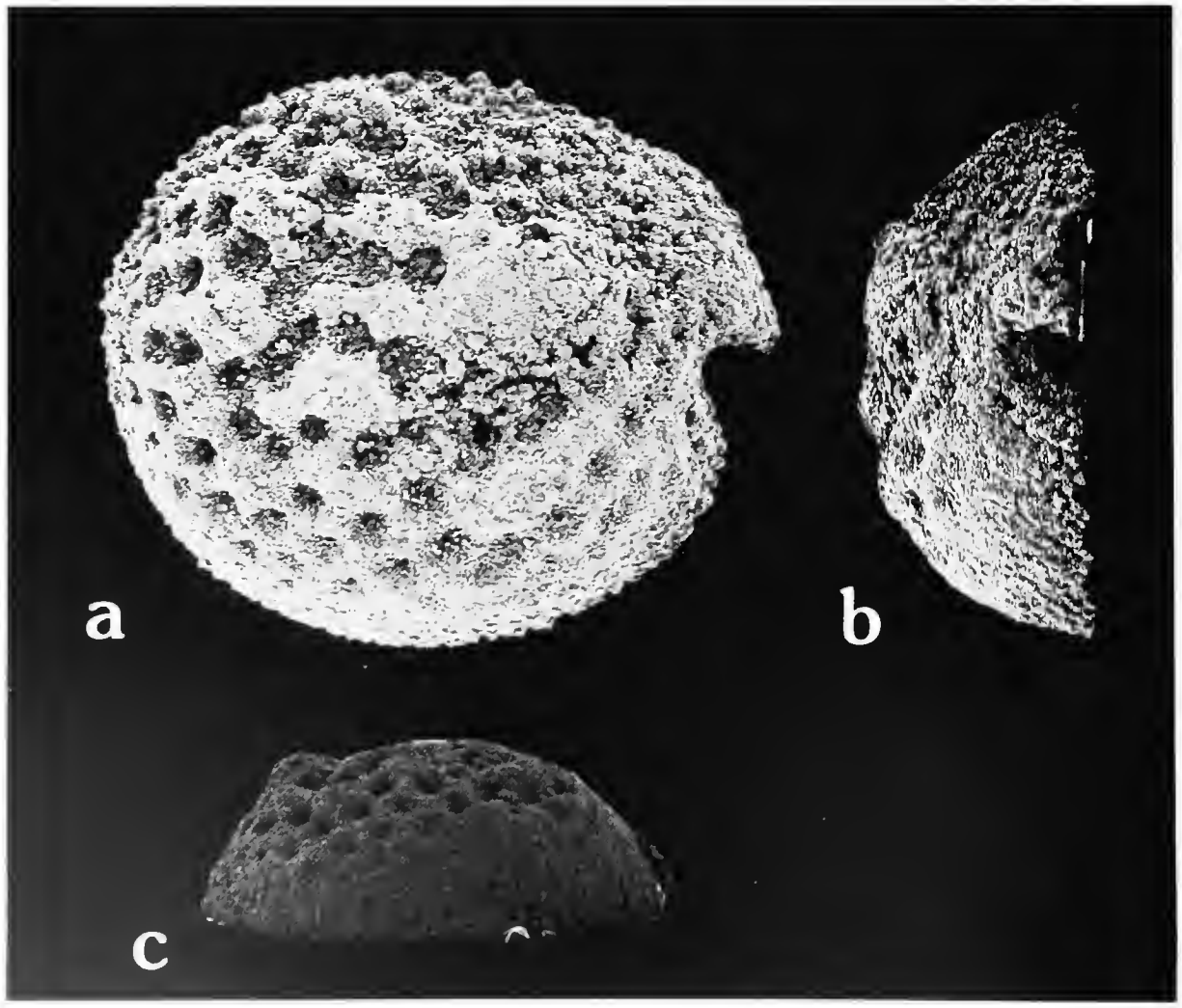


FIGURE 12.—*Swainella bex,* new species, holotype, USNM 496725, RV, length 1.59 mm: *a,* lv, × 35.2; *b,* av, ×35; *c,* oblique vv, × 28.4.

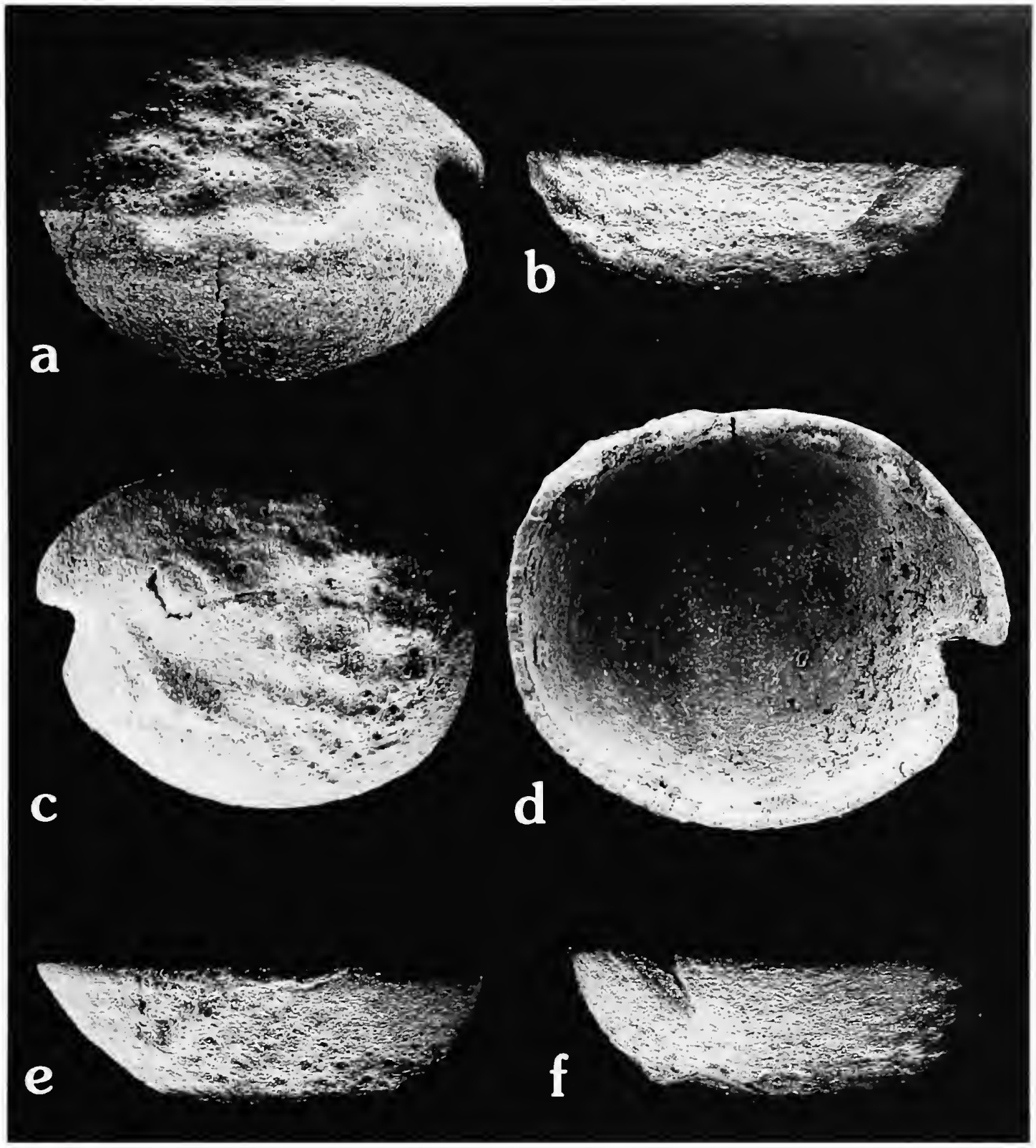


FIGURE 13.—*Swainella bex,* new species. Paratype, USNM 496713, RV, length 1.33 mm: *a,* lv, × 50; *b,* anterodorsal? view, anterior to right, × 50. Paratype, USNM 496712, LV, length 1.39 mm: *c,* lv, × 50; *d,* iv, × 50; *e,* dv, × 50; *f,* anterodorsal? view, × 50.

Suborder MYODOCOPINA Sars, 1866

COMPOSITION.—The Myodocopina includes the superfamilies Cypridinacea, Sarsiellacea, and Cylindroleberidacea.

DIAGNOSIS.—*Carapace:* Carapace without subcentral node, smooth or ornamented; dorsal border straight or arched. Adult males generally more elongate than females. Rostrum well developed or absent, generally differing in adult males and females; tip of rostrum truncate, rounded, or pointed. Caudal process well developed or absent. *Appendages:* Coxal endite (usually present) of mandible spiny or serrate lobe; 5th limb (2nd maxilla) compacted (not leg-like) (reduced in some males); 6th limb short and flat; male copulatory limbs paired; 7th limb (present in almost all adults) long, worm-like, unsegmented but with many annulations.

RANGE.—Silurian to Holocene.

Key to Superfamilies of the Myodocopina

(Key includes characters of most members of each superfamily and applies only to taxa reported from the Paleozoic and/or Mesozoic)

1. Tip of rostrum truncate ..... **SARSIELLACEA**
   Tip of rostrum rounded or pointed 2
2. Rostrum and incisur well developed ..... **CYPRIDINACEA**
   Rostrum and incisur poorly developed ..... **CYLINDROLEBERIDACEA**

SARSIELLACEA Brady and Norman, 1896

COMPOSITION.—The Sarsiellacea includes the families Sarsiellidae, Rutidermatidae, and Philomedidae. None of these has been reported from the Mesozoic, and only the Philomedidae has been reported from the Paleozoic.

DIAGNOSIS.—Carapace with minute rostrum in adult female and prolonged in adult male; caudal process usually present in adult females, longer in adult males; dorsal margin of carapace convex; surface smooth or ornamented. Adult males usually more elongate than adult females.

RANGE.—Carboniferous to Holocene.

PHILOMEDIDAE Müller, 1912

COMPOSITION.—The Philomedidae includes two subfamilies: Philomedinae and Pseudophilomedinae. The former has been reported in the Paleozoic.

DIAGNOSIS.—Rostrum and caudal process usually well developed; surface smooth or ornamented; dorsal margin of carapace straight or arched; rostrum truncate, rounded, or pointed; carapace usually with small caudal process. Adult males usually more elongate than adult females, and with more open incisure.

RANGE.—Carboniferous to Holocene. Holocene taxa are cosmopolitan, with a known depth range of intertidal to 3382 m.

PHILOMEDINAE Müller, 1912

COMPOSITION.—The Philomedinae includes many genera, mostly Recent.

DIAGNOSIS.—Rostrum usually truncate.

RANGE.—Carboniferous to Holocene.

Philomedes Liljeborg, 1853

Philomedes Liljeborg, 1853:175.
Bradycinetus Sars, 1866:109.

TYPE SPECIES.—*Philomedes longicornis* Liljeborg, 1853:176 (= *Cypridina Brenda* Baird, 1850).

DIAGNOSIS.—Same as for subfamily.

RANGE.—Same as for subfamily.

Philomedes rankiniana (Jones and Kirkby, 1867), new combination

FIGURE 14

Cypridina rankiniana Jones and Kirkby, 1867:218; 1871:27.
Bradycinetus rankiniana (Jones and Kirkby, 1867).—Jones and Kirkby, 1874: 42, pl. II: figs. 21, 22a–c; pl. V: fig. 5.

HOLOTYPE.—*Philomedes rankiniana* (Jones and Kirkby, 1867).

TYPE LOCALITY.—Carboniferous, Scotland.

MATERIAL.—Permian: USNM locality 9260, Hydra, Greece, USNM 496710, complete carapace (at present fragmented).

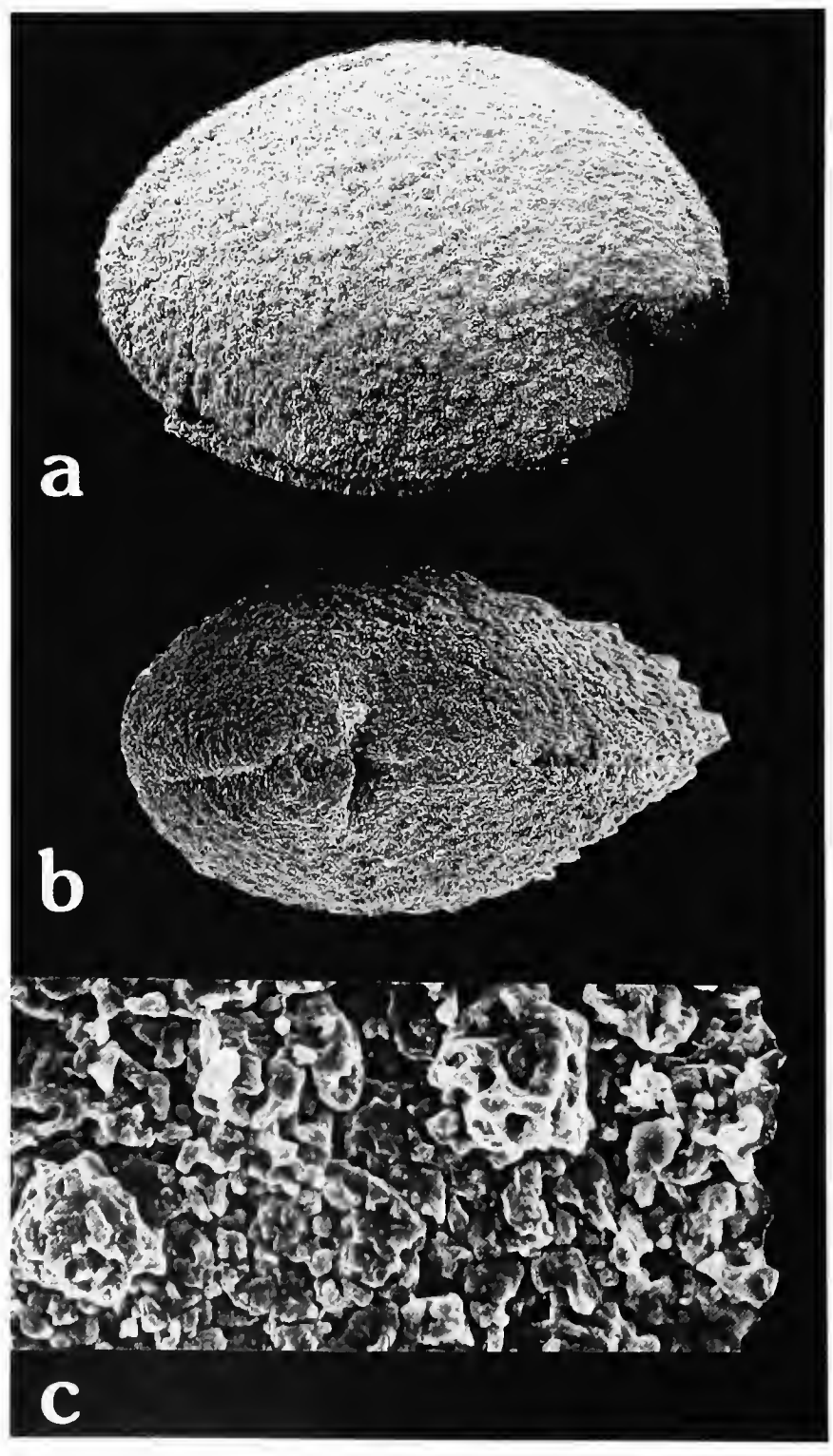


FIGURE 14.—*Philomedes rankiniana*, USNM 496710, complete carapace, length 1.00 mm: *a*, lv, × 75; *b*, vv, × 75; *c*, detail of surface in *a*, × 800. (Original magnifications of micrographs reduced to 84% for publication.)

DISTRIBUTION.—Carboniferous of Scotland, Ireland?, and Great Britain?; Permian of Hydra, Greece.

DESCRIPTION OF HYDRA SPECIMEN.—Carapace oval in lateral view, with rounded incisur and square-tipped rostrum (Figure 14*a*). Dorsal end of square-tipped rostrum forming most anterior projection of valve. Posterior margin slightly less rounded in dorsal half (Figure 14*a*). Left valve overlapping right along margins (Figure 14*a,b*). In ventral view, posterior half of valve more acuminate than anterior half (Figure 14*b*). Width of carapace less than ½ of length.

Ornamentation: Surface with many minute papillae (Figure 14). Lateral nodes absent.

Hinge: Not observed.

Infold: Not observed.

Carapace Size (in mm): USNM 496710, complete carapace, L=1.00.

CYPRIDINACEA Baird, 1850

COMPOSITION.—The Cypridinacea includes the family Cypridinidae.

DIAGNOSIS.—For fossil taxa, diagnosis same as for the Cypridinidae below.

RANGE.—Silurian to Holocene.

CYPRIDINIDAE Baird, 1850

COMPOSITION.—This family includes two subfamilies: Cypridininae Baird, 1850, and Azygocypridininae Kornicker, 1970. The latter is known only from the Holocene. The Cypridininae as interpreted herein is present in the Paleozoic and Holocene but not in the Mesozoic. Its presence in the Tertiary is outside the scope of the present study.

DIAGNOSIS.—Carapace usually smooth; dorsal border arched. Rostrum well developed, evenly curved or sinuous. Caudal process either small or well developed.

RANGE.—Silurian to Holocene. Holocene taxa are circumglobal, with a depth range of intertidal to abyssal.

CYPRIDININAE Baird, 1850

COMPOSITION.—This subfamily includes two tribes: Cypridinini Baird, 1850, and Gigantocypridinini Hartmann, 1974. The latter is known only from the Holocene. The Cypridinini as interpreted herein is present in both the Holocene and the Paleozoic.

DIAGNOSIS.—Same as for family. Carapaces of the Gigantocypridinini longer than 4 mm.

RANGE.—Silurian to Holocene.

CYPRIDININI Baird, 1850

COMPOSITION.—This tribe includes approximately 21 Holocene genera and three genera known only as fossils.

DIAGNOSIS AND RANGE.—Same as for family.

REMARKS.—It is possible that the Carboniferous *Eocypridina* Kesling and Ploch, 1960, which is referred herein to the superfamily Cylindroleberidacea, could be a member of the Cypridinini.

Key to Genera of the Cypridinini

(Key applies only to taxa reported from the Paleozoic and Mesozoic)

1. Carapace with nuchal furrow. . . . . ***Palaeophilomedes***
   Carapace without nuchal furrow 2
2. Anteroventral prow produced . . . . . ***Cypridinella***
   Anteroventral prow not produced . . . . . ***Silvesterella,*** new genus

Cypridina Milne-Edwards, 1840

TYPE SPECIES.—*Cypridina renaudii* Milne-Edwards, 1840: 409, by monotypy.

COMPOSITION.—Kornicker (1991:27) recognized 21 Holocene *Cypridina* species sensu Poulsen (1962:255). Because many Paleozoic species have been incorrectly referred to *Cypridina* (e.g., Jones and Kirkby, 1874), a discussion of the genus is included.

DIAGNOSIS.—The description of the shell of the genus by Skogsberg (1920:313) included the following: "Shell rather elongated; rostrum always with a distinct ventral corner; rostral incisur comparatively narrow and moderately deep, sometimes even shallow; posterior of shell with well-developed beak-shaped process [caudal process]." Poulsen (1962:255), in a diagnosis of the genus, was essentially in agreement with Skogsberg's description above, but added: "The antero-superior corner of the rostrum is protruding over the front margin; the 'corner' is as a rule rounded, in a single species pointed. The incisur is rather short and broad. The posterior shell process [caudal process] is always well developed, varying somewhat in size and form."

RANGE.—Holocene.

REMARKS.—Holocene species are present in the Indian and Pacific oceans between latitudes of about 35°N and 30°S, planktonic and demersal.

DISCUSSION.—A basic problem with this genus is the inadequate description of the type species. The illustrations of the type species by Milne-Edwards (1840, pl. 36: figs. 5, 5a) is of a shell without an anterior incisur. Skogsberg (1920:316) attrib-

uted the absence of the incisur to mistakes in observation by Milne-Edwards. His conclusion is supported by a statement in a prior publication of Jones and Kirkby (1874:11): "In a courteous reply to an inquiry with which I troubled M. Milne-Edwards, he kindly informed me that the *Cypridina* described in the 'Hist. Nat. des Crust' has really the antero-ventral notch so characteristic of the genus."

Müller (1912:52) referred the type species to "Cypridinarum genera dubia et species dubiae." On the other hand, Skogsberg (1920:316) concluded that "as no other forms either—except those belonging to *Pyrocypris*—are known so far, which can with any great probability be considered as closely related to the species described by Milne-Edwards, it seems to me justifiable and convenient to use the name *Cypridina* for the last mentioned group of forms." (*Pyrocypris* is a genus proposed by Müller (1906:16) that has been correctly referred to *Cypridina*). Skogsberg (1920:313), in a synonymy of the subgenus *Cypridina,* listed as "Non *Cypridina*" fossil ostracodes identified by Bosquet (1847) and other authors.)

Sylvester-Bradley (1951:209) stated that "it is probable that all Paleozoic specimens referred to *Bradycinetus* and also to *Cypridina,* should more correctly be assigned to new genera, most of which would belong to families other than Rhombinidae." Sylvester-Bradley (1961:Q399) confined the range of *Cypridina* to the Recent.

Poulsen (1962:255) mentioned the difficulty of referring species to the genus *Cypridina* because of the very incomplete description of *C. renaudii,* but he did recognize the genus. We conclude that fossil species without a caudal process, as well as fossils with lateral nodes, should not be referred to *Cypridina* Milne-Edwards, 1840.

Palaeophilomedes Sylvester-Bradley, 1951

TYPE SPECIES.—*Philomedes bairdiana* Jones and Kirkby, 1874.

COMPOSITION.—In addition to the type species, we include in the genus *Philomedes elongata* Jones, Kirkby, and Brady, 1884, and *Palaeophilomedes neuvillensis* Casier, 1988.

DIAGNOSIS.—Posterior margin triangular; each valve with short nuchal furrow pointing toward posteroventral corner.

RANGE.—Upper Devonian (Casier, 1988:90); Carboniferous (Sylvester-Bradley, 1961:Q403).

Cypridinella Jones and Kirkby, 1874

TYPE SPECIES.—*Cypridinella cummingii* Jones, Kirkby, and Brady in Jones and Kirkby, 1874, subsequent designation by Bassler and Kellett, 1934:44. Howe (1955:47, 1962:59) stated that "the genotype is therefore *Cypridinella monitor* Jones, 1873a, not *C. cummingii* as designated by Bassler and Kellett, 1934, p. 44." Howe's conclusion apparently was based on the statement by Jones (1873b:410) that the carapace of *C. monitor* is typical of the genus. We do not concur with Howe because Article 67, International Code of Zoological Nomenclature (1985), states otherwise.

Sylvester-Bradley (1961:Q402) proposed the family Cypridinellidae for the genera *Cypridinella, Cypridella, Cypridellina,* and *Sulcuna.* The last three genera are referred herein to the family Cypridinellinidae.

DIAGNOSIS.—Sylvester-Bradley (1961:Q402): "Anteroventral margin extending past tip of rostrum; incisur narrow and horizontal; carapace length 2 to 10 mm."

RANGE.—Carboniferous.

Sylvesterella, new genus

ETYMOLOGY.—The genus is named in honor of P.C. Sylvester-Bradley.

TYPE SPECIES.—*Cypridina oblonga* Jones and Kirkby, 1874.

DIAGNOSIS.—Posterior margin evenly curved; carapace without nuchal furrow.

RANGE.—Carboniferous.

Sylvesterella oblonga (Jones and Kirkby, 1874), new combination

Cypridina oblonga Jones and Kirkby, 1874:20, pl. V: fig. 12a–c.—Jones, Kirkby, and Brady, 1884:90.

Rhombina oblonga (Jones and Kirkby, 1874).—Sylvester-Bradley, 1951:210, pl. XI: figs. 1–4; 1961:Q403, Q405, fig. 326:2a).

HOLOTYPE.—Sylvester-Bradley (1951:210–211): "Imperfect right valve (rostrum missing). Figured upside down by Jones and Kirkby, 1874 (pl. 5: fig. 12a), and interpreted by them as left valve. The so-called beak of their figure is an irregular crack. British Museum No. I. 6267."

DESCRIPTION.—Sylvester-Bradley (1951:210): "Rostrum large, down-curved. Dorsal margin curved. Anteroventral margin receding. Posterior tumid, with a large, ill-defined, oval protuberance, sloping steeply to posterior margin. A slight furrow parallel to the venter delineates a marginal rim. Surface covered with faint papillae. Muscle-scar pattern consisting of an approximate triangular group of irregular, elongated scars, presenting certain points of resemblance to the muscle-scar patterns of recent Myodocopa. Length: 6 to 7½ mm."

RANGE.—Carboniferous.

"Cypridinid" sensu Siveter et al., 1987

Siveter et al. (1987:794, 800) referred one Silurian species to "Cypridinid" gen. et sp. nov. A, a second to "Cypridinid" gen. et sp. nov. B, and a third to "Cypridinid" sp.

DIAGNOSIS.—Siveter et al. (1987:793): "Oval, dome-like shells that differ considerably from bolbozoids in muscle scar pattern, in being relatively shorter and higher, and in lacking sulci or an anterodorsal bulb (see pl. 84: fig. 1; pl. 85: figs. 1, 2). The general designation 'cypridinid' is employed herein for

these forms. Their shape and outline is comparable with Devonian and Carboniferous cypridinids (Bless, 1973; Sohn, 1977), Mesozoic myodocopids such as *Triadocypris* (Weitschat, 1983b), and particularly with the Recent cypridinacean families Cypridinidae, Philomedidae, and Cylindroleberididae (see pl. 88; Kornicker, 1975, 1981; Kornicker and Caraion, 1978)."

RANGE.—Silurian.

REMARKS.—Until the unnamed genera and species are described, we provisionally refer the myodocopids listed by Siveter et al. (1987) to the Cypridinidae, subfamily Cypridininae, tribe Cypridinini. (As of September, 1997, the taxa had not been formally described (in litt., Siveter, 1997).)

"Cypridinid" Genus A, Siveter et al., 1987

REVIEW.—Siveter et al. (1987) considered the genus to be new.

RANGE.—Silurian.

Genus A, Species A, Siveter et al., 1987

REVIEW.—Siveter et al. (1987) considered the species to be new. Whatley et al. (1993:350) referred this taxon to the Cypridinidae Baird, 1850.

DIAGNOSIS.—Siveter et al. (1987:799–800): "A regular pattern of shallow, elliptical to polygonal fossae (each 100–300 μm across) covers the posterior half of the valve (pl. 84: figs. 1, 3). In many cases both the smaller, granule-like elements and the perforated polygonal platelets (combined range: 10–150 μm diameter) occur as a gradational, intermingled pattern on individual valve (e.g., pl. 87: fig. 5)."

The perforated polygonal platelets should not be considered as true external ornament.

RANGE.—Silurian.

"Cypridinid" Genus B, Siveter et al., 1987

REVIEW.—Siveter et al. (1987:794) considered the genus to be new.

RANGE.—Silurian.

Genus B, Species B, Siveter et al., 1987

REVIEW.—Siveter et al. (1987) considered this to be a new species.

DIAGNOSIS.—Siveter et al. (1987:799–800): "In many cases both the smaller, granule-like elements and the perforated polygonal platelets (combined range: 10–150 μm diameter) occur as a gradational, intermingled pattern on individual valve (e.g., pl. 87: fig. 4). The perforated polygonal platelets should not be considered as true external ornament. Radiate microstructures (pl. 87: figs. 2–4) also should not be considered as true external ornament."

RANGE.—Silurian.

CYLINDROLEBERIDACEA Müller, 1906

COMPOSITION.—The Cylindroleberidacea includes the family Cylindroleberididae.

DIAGNOSIS.—Carapace shape and ornamentation extremely variable; carapaces of Cylindroleberidinae and Cyclasteropinae generally appearing smooth, whereas those of Asteropteroninae generally with ribs and processes; incisur slit-like in Cylindroleberidinae and Cyclasteropinae, and forming a right or acute angle in Asteropteroninae.

RANGE.—Permian to Holocene.

CYLINDROLEBERIDIDAE Müller, 1906

COMPOSITION.—The Cylindroleberididae includes three subfamilies: Cylindroleberidinae Müller, 1906; Cyclasteropinae Poulsen, 1965; and Asteropteroninae Kornicker, 1981. The Asteropteroninae is represented in the Permian, and the Cyclasteropinae is represented in the Triassic.

DIAGNOSIS.—Same as for family.

RANGE.—Permian to Holocene. Holocene taxa are circumglobal, with depth range of intertidal to abyssal.

Key to Paleozoic and Mesozoic Subfamilies of the Cylindroleberididae

(Key includes characters of most members of each superfamily)

Incisur long slit-like . . . . . **CYCLASTEROPINAE**

Incisur short, forming right angle between ventral edge of rostrum and anterior edge of valve ventral to rostrum . . . . . **ASTEROPTERONINAE**

ASTEROPTERONINAE Kornicker, 1981

COMPOSITION.—The Asteropteroninae includes three genera in the Paleozoic and/or Mesozoic: *Triadocypris, Triadogigantocypris,* and *Siveterella,* new genus.

DIAGNOSIS.—Carapace generally oval in lateral view, but some with posterodorsal projections; incisur generally forming right angle between ventral margin of rostrum and anterior margin of valve below rostrum; surface generally with ribs and large processes.

RANGE.—Permian to Holocene. Holocene taxa from about 42°S to 42°N, with depth range mostly shallower than 100 m, but maximum known depth range 1100 m (Kornicker, 1981:189).

DISCUSSION.—We consider the referral of *Triadogigantocypris* to the Asteropteroninae to be tentative.

REMARKS.—The surface ridges of many genera of "fingerprint" ostracodes included in the ?Entomozoacea by Sylvester-Bradley (1961:Q388) resemble those of *Asteropella kalkei* Kornicker, 1986b (fig. 56). These genera are *Bertillonella* Stewart and Hendrix, 1945; *Entomoprimitia* Kummerow, 1939; *Nehdentomis* Matern, 1929; *Richteria* Jones, 1874; *Richterina* Gürich, 1896; *Fossirichterina* Matern, 1929; *Maternella* Rabien, 1954; and *Volkina* Rabien, 1954. Whatley et al. (1993:350) referred the families, within which those genera are usually placed, to either the Halocypridina and Cladocopina. We have similar reservations about referring those genera to the Myodocopina, and they are not considered further herein.

Key to Genera of the Asteropteroninae

(Key applies only to taxa reported from the Paleozoic and/or Mesozoic)

1. Surface with nodes ..... ***Siveterella,*** new genus
   Surface without nodes 2
2. With caudal process ..... ***Triadogigantocypris***
   Without caudal process ..... ***Triadocypris***

Triadocypris Weitschat, 1983

TYPE SPECIES.—*Triadocypris spitzbergensis* Weitschat, 1983a.

COMPOSITION.—This genus includes *Triadocypris spitzbergensis* Weitschat, 1983a, from the Triassic of Spitzbergen, and a new species from the Permian.

DIAGNOSIS.—Carapace oval in lateral outline, rostrum small with minute incisur; inner lamella narrow and calcified; with numerous radial pore canals. Adductor muscle scar pattern consisting of two diagonal rows of scars (based on carapace diagnosis in Weitschat, 1983a:314).

Weitschat (1983b:127) added to the diagnosis of the carapace, "Myodocopid with carapace 2.9–3.1 mm long. With small rostrum and narrow rostral incisur. Posterior margin forming angle at midpoint. Left valve overlaps right. With delicate dentition along dorsal margin of each valve. Ornamentation composed of small, closely spaced pits."

RANGE.—Permian to Triassic.

DISCUSSION.—The shape of the carapace, the small rostrum, the lack of a deep incisur, and the convex dorsal margin of left valve visible in dorsal view (Figure 15*b*) of *T. pax* closely resemble carapaces of species of the extant species *Actinoseta jonesi* (Kornicker, 1981, pls. 62a, 63a,e); this suggests that the genus *Triadocypris* should be referred to the Asteropteroninae. It is not known if the fossil specimens of *Triadocypris* have the posterodorsal tooth-and-socket structures present on Recent species of *Actinoseta* (see Kornicker 1981, pls. 57e,f, 58a,b). Weitschat (1983b:127) mentioned "delicate dentition along dorsal margin of each valve."

REMARKS.—The legend to pl. 10: figs. 1, 2 of *Triadocypris spitzbergensis* in Weitschat (1983b:127) stated that both illustrations are of specimen number GPIHM 2559. Actually, figs. 1 and 2 are from different specimens (in litt., Weitschat, 1997). Cohen et al. (1998) referred this species to a new family, Triadocypridinae, but because it is based on soft parts of the unique fossil, we do not think it practical to use the new family when identifying fossils.

Triadocypris pax, new species

FIGURE 15

ETYMOLOGY.—From the Latin *pax* (peace).

HOLOTYPE.—USNM 496722, complete carapace (broken in half after micrography).

TYPE LOCALITY.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1974.

PARATYPE.—USNM locality 9260, USNM 496728 (lost), complete specimen with valves askew.

DISTRIBUTION.—USNM locality 9260, Hydra, Greece.

DESCRIPTION.—Carapace oval in lateral view with slightly projecting rostrum and with minute incisur just ventral to valve midheight (Figure 15*a,d*). In dorsal and ventral view, carapace broadest at ⅔ valve length measured from anterior end of valve; carapace acuminate anterior to broadest part.

Ornamentation: Surface with abundant minute pits (Figure 15).

Hinge: Not observed in detail but located in posterior half of dorsal margin.

Infold: Unknown.

Central Adductor Muscle Scars: Unknown.

Carapace Size (in mm): Holotype, USNM 496722, L= ~1.6, H=~1.2.

COMPARISONS.—Rostrum and incisur much larger in *T. spitzbergensis.*

Siveterella, new genus

ETYMOLOGY.—Named in honor of David Siveter, prominent ostracodologist.

TYPE SPECIES.—*Siveterella pax.*

DIAGNOSIS.—Carapace oval in lateral view, with short rostrum and rounded posterior without caudal process.

RANGE.—Permian.

DISCUSSION.—The resemblance of the many nodes on the carapaces of *S. pax* and *S. flex* compared to those of *Actinoseta*

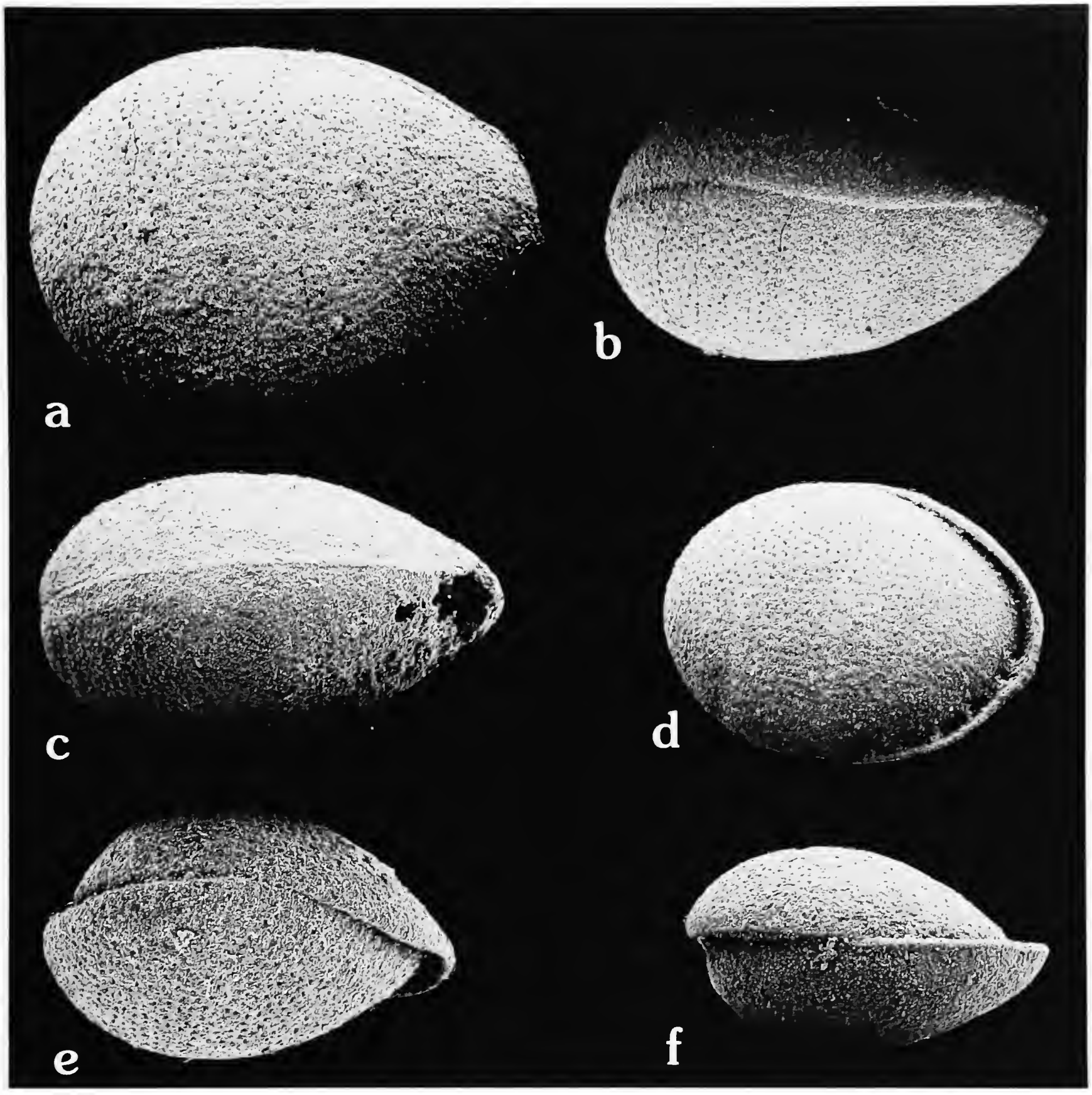


FIGURE 15.—*Triadocypris pax,* new species. Holotype, USNM 496722, complete specimen broken after micrography, length ~1.6 mm: *a,* lv, × 50; *b,* dv, anterior to right, × 50; *c,* vv, anterior to right, × 50. Paratype, USNM 496728, complete specimen (valves askew), length unknown: *d,* lv; *e,* dv, anterior to right; *f,* vv, anterior to right.

chelisparsa Kornicker, 1958 (see Kornicker, 1981, fig. 52a–c) and *Actinoseta nodosa* Kornicker, 1981 (see figs. 66a,b,d, 67a) suggested that the genus be referred to the Asteropteroninae. The carapaces of known species of *Siveterella* do not have the posterodorsal tooth-and socket structures present on Recent species of *Actinoseta* (Figures 17*a,* 20*a,c*).

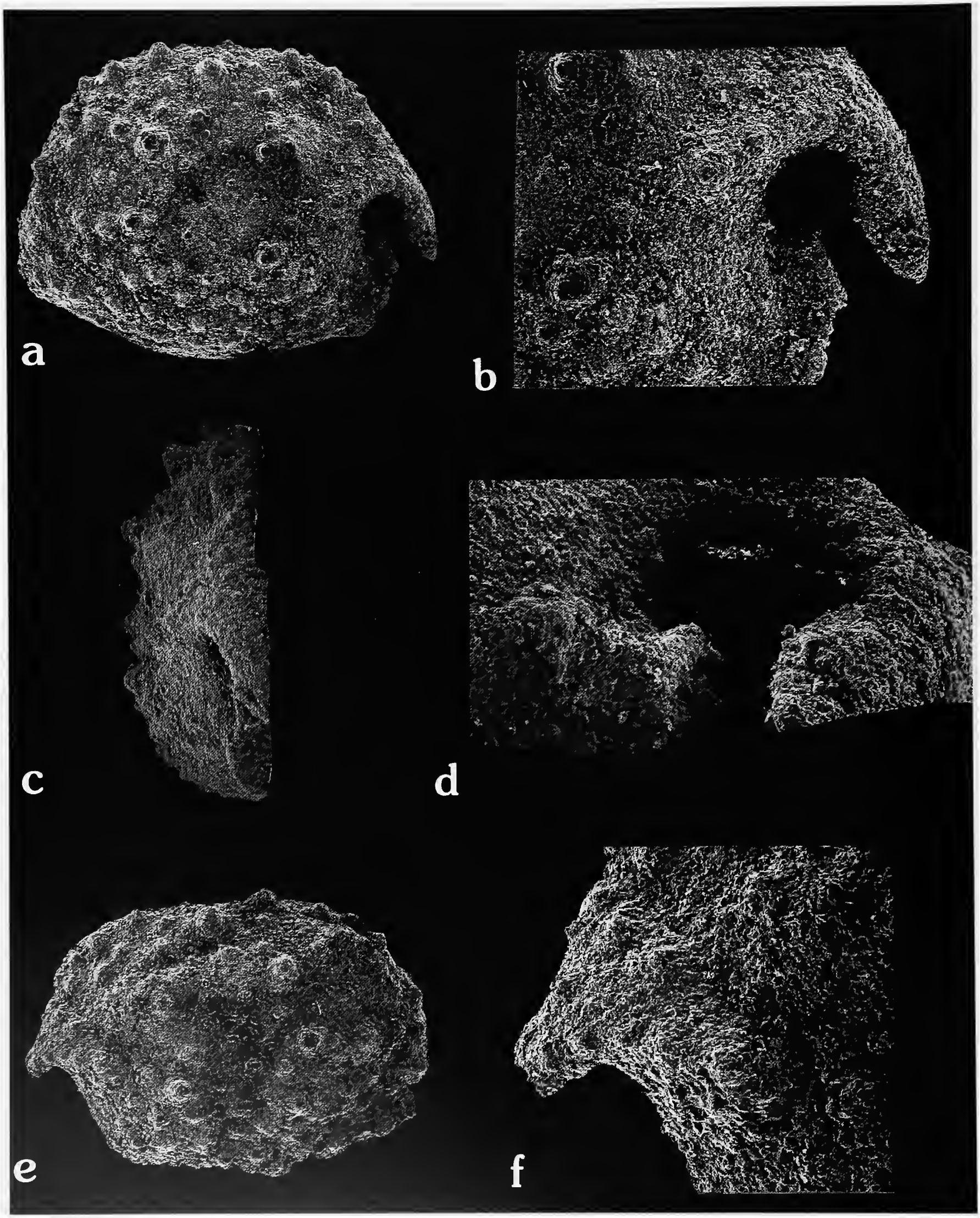
Siveterella pax, new species

FIGURES 16, 17

ETYMOLOGY.—From the Latin *pax* (peace, tranquility).

HOLOTYPE.—USNM 496730, RV.

TYPE LOCALITY.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1968.


a
b
c
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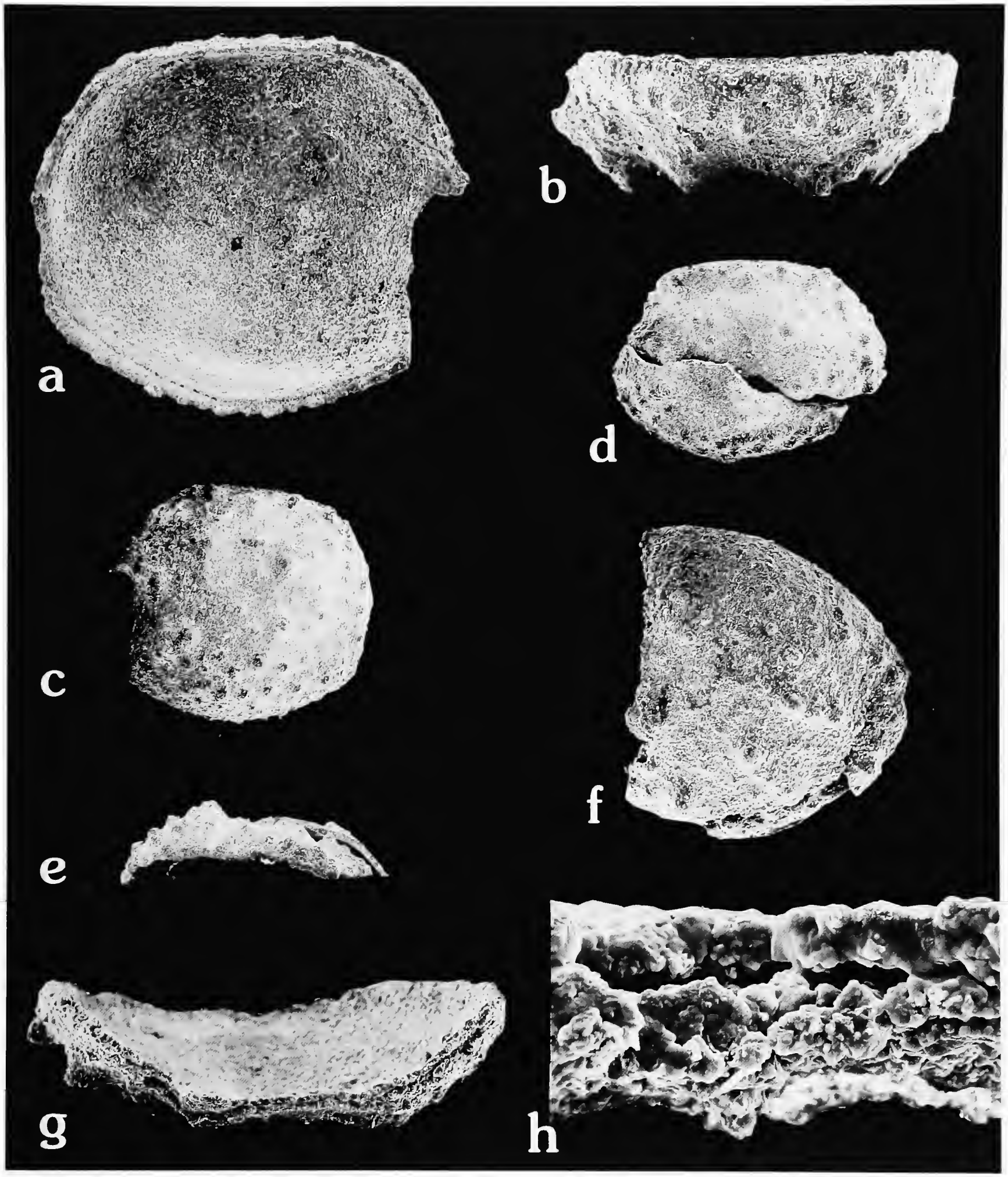

FIGURE 16 (opposite).—*Siveterella pax,* new species. Holotype, USNM 496730, RV, length 2.15 mm: *a,* lv, ×37.4; *b,* detail of anterior, from *a,* ×78; *c,* av, ×40.2; *d,* anteroventral view of rostrum and incisur, ×146. Paratype, USNM 496731, LV, length 2.41 mm: *e,* lv, ×33.2; *f,* detail of anterior, from *e,* ×88. (Original magnifications of micrographs reduced to 82% for publication.)

FIGURE 17 (above).—*Siveterella pax,* new species. Paratype, USNM 496733, LV?, length of fragment 2.00 mm: *a,* iv, × 40; *b,* dv?, ×40; *c,* lv, ×24. USNM 496734, valve broken into 2 pieces, length of assembled pieces 1.96* mm: *d,* lv, ×28; *e,* dv?, ×28. USNM 496732, broken valve, length of small fragment (more than about ½ total length), 1.19 mm: *f,* lv, ×50; *g,* end view, from *f,* ×75; *h,* detail from *g,* ×740. (Original magnifications of micrographs reduced to 87% for publication.)

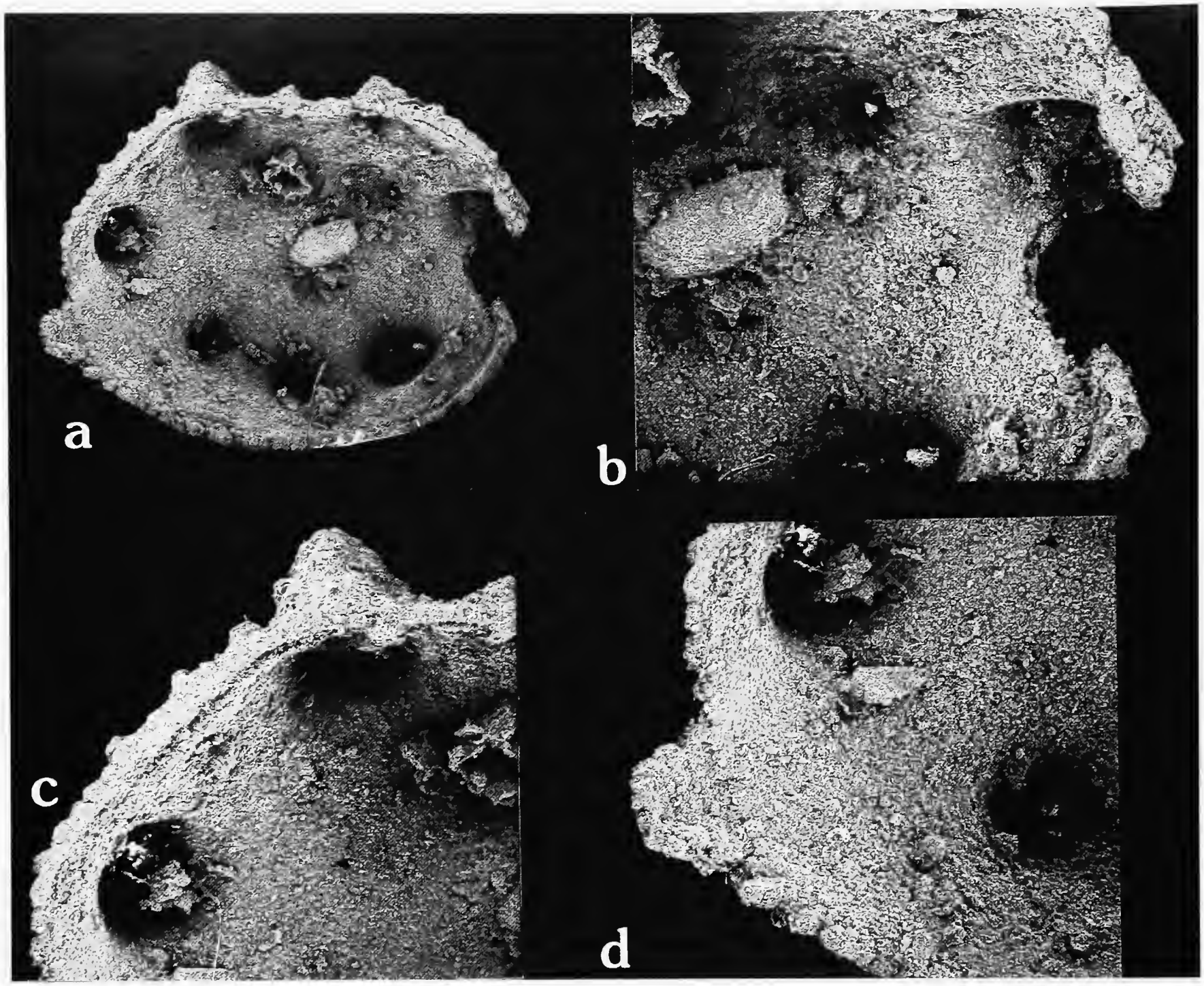

FIGURE 18.—*Siveterella flex,* new species, holotype, USNM 496729, LV, length 4.43* mm: *a,* iv, × 24.8; *b,* detail of anterior, from *a,* × 57; *c,* detail of posterior, from *a,* × 59; *d,* detail of caudal process, from *c,* × 132. (Original magnifications of micrographs reduced to 89% for publication.)

PARATYPES.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1968: USNM 496731, LV. USNM locality 9260, Hydra, Greece 1, 21 Aug 1968: USNM 496732, broken valve. USNM locality 9262, Hydra, Greece, 23 Aug 1968: USNM 496733, LV?; USNM 496734, broken valve.

DISTRIBUTION.—USNM localities 9260 and 9262, Hydra, Greece.

DESCRIPTION (Figures 16, 17).—Carapace oval in lateral view with deep incisur (Figure 16*a,c,d*).

Ornamentation: Surface of valves with numerous rounded nodes (Figures 16*a,b,e,* 17*b–g*).

Hinge: None evident.

Infold: None preserved (Figure 17*a*).

Central Adductor Muscle Scars: Unknown.

Carapace Size (in mm): Holotype, USNM 496730, L=2.15, H=1.66. Paratypes: USNM 496731, LV, L=2.41, H=1.55; USNM 496732, length of small fragment (more than about ½ total length)=1.19; USNM 496733, LV?, L=2.00, H=1.73; USNM 496734 (broken), L=1.96.

Siveterella flex, new species

FIGURES 18, 19

ETYMOLOGY.—An arbitrary combination of letters.

HOLOTYPE.—USNM 496729 (lost), LV.

TYPE LOCALITY.—USNM locality 9260, Hydra, Greece 2, 4 Jul 1968.

PARATYPES.—None.

DISTRIBUTION.—USNM locality 9260, Hydra, Greece.

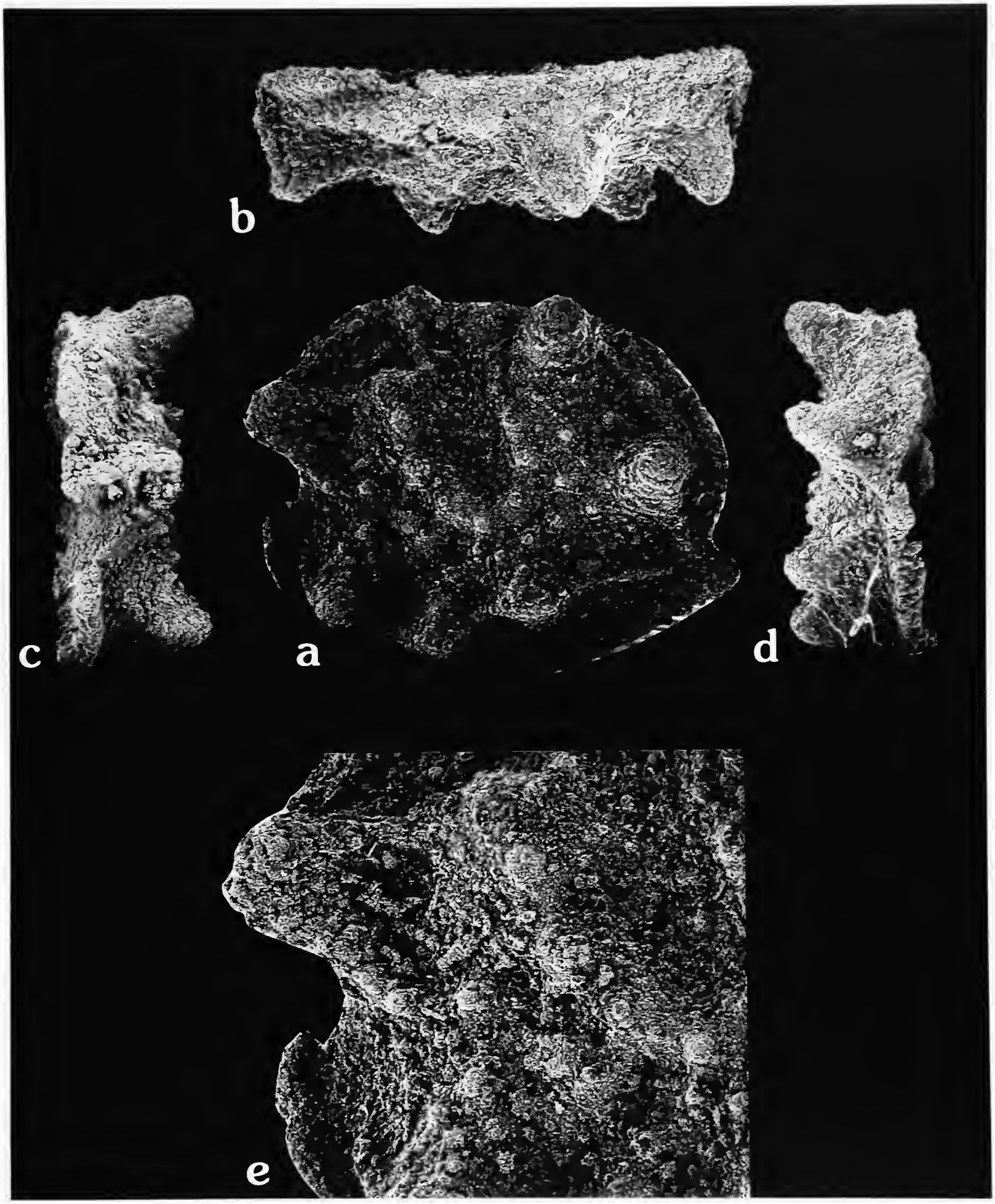

FIGURE 19.—*Siveterella flex,* new species, holotype, USNM 496729, LV, length 4.43 mm: *a,* lv, × 31.8; *b,* dv, × 35.2; *c,* av, × 25.6; *d,* pv, × 25.8; *e,* detail of anterior, from *a,* × 59.

DESCRIPTION (Figures 18, 19).—Carapace oval in lateral view (Figures 18*a*, 19*a*) with short rostrum (Figures 18*a,b*, 19*a,e*) and small caudal process (Figures 18*a,d*, 19*a,*). Outer surface with large nodes reflected on inside surface by depressions.

Ornamentation: Surface with 8 or 9 large round tapered processes (3 just inward from ventral margin; 1 inward from posterior margin at midheight; 1 anterior and 1 posterior to valve midlength along dorsal margin; 2 near midlength inward from dorsal margin; and 1 at valve middle in vicinity of central adductor muscle attachment) (Figures 18, 19). In inside view of valve, processes appear as round depressions (Figure 18). Rounded process also at tip of rostrum (Figure 19*a,e*). Surface of valve between large processes with small nodes (Figure 19*a,e*).

Central Adductor Muscle Scars: None evident.

Hinge: Straight posterodorsal margin suggests hinge present in that section (Figure 18*a,c*).

Infold: None preserved (Figure 18).

Carapace Size (in mm): L=4.43, H=2.79.

COMPARISONS.—Differs from *Siveterella pax* in having a more pronounced projecting posteroventral caudal process and larger surface nodes.

Triadogigantocypris Monostori, 1991

TYPE SPECIES.—*Triadogigantocypris balatonica,* Monostori, 1991.

Although Monostori (1991:92) referred the only species he considered (*T. balatonica*) to the Cypridinidae, he stated (1991: 95) that "the arcuate arrangement of some muscle scars resembles the spirally arranged scars of the family Cylindroleberididae G.W. Müller, 1906."

DIAGNOSIS.—Large oval carapace with rostrum; anteroventral margin not reaching tip of rostrum. Muscle scars consisting of 4 or 5 oblique scars anteroventral to fan of straight to arcuate scars.

RANGE.—Triassic to Cretaceous.

DISCUSSION.—*Philomedes donzei* Neale (1976:9) was not mentioned in Monostori (1991). The carapace and muscle scars of *P. donzei* resemble somewhat those of *T. balatonica,* and we tentatively refer *P. donzei* to *Triadogigantocypris* herein.

Triadogigantocypris balatonica Monostori, 1991

Triadogigantocypris balatonica Monostori, 1991:94–95, fig. 2.

HOLOTYPE.—Steinkern deposited in Paleontological Department of the Hungarian Natural History Museum, catalog number M. 90.1.

DIAGNOSIS.—Adductor muscle scar pattern consisting of 5 oblique scars anteroventral and posterior to fan of about 10 arcuate scars; a third set of about 5 smaller scars dorsal to scar fan (Monostori, 1991:92, fig. 2).

RANGE.—Lower Ladinian, Middle Triassic, Hungary.

Triadogigantocypris donzei (Neale, 1976), new combination

Cypridina? sp. nov. A, Donze, 1965:100, 101, pl. 3: figs. 71–74.
Philomedes donzei (Donze, 1965).—Neale, 1976:9–12, text-figs. 1–3.

HOLOTYPE.—University of Hull collection number HU.152.C.1, carapace.

DIAGNOSIS.—Carapace thick shelled; tip of rostrum rounded; male carapace more elongate than that of female. Muscle scars consisting of 4 oblique scars anteroventral to fan of 5 straight scars and also anterior to 2 short vertical scars (Neale, 1976, text-fig. 1).

RANGE.—Basal Valanginian, Lower Cretaceous, France.

CYCLASTEROPINAE Poulsen, 1965

COMPOSITION.—The Cyclasteropinae includes three tribes: Cycloleberidini Hartmann, 1974; Cyclasteropini Poulsen, 1965; and Tetraleberidini Kornicker, 1981.

DIAGNOSIS.—Carapace usually oval in adult females and juveniles, elongate in adult males; fairly deep incisur present below rostrum; carapace of adult males usually about same size as adult females; adductor muscle attachment scars elongate, oval, and often appearing as spiral.

RANGE.—Upper Devonian to Holocene. Holocene taxa have been reported from about 46°S (in the vicinity of New Zealand) to about 42°N (in the Mediterranean); depth range shallow to 290 m (rarely 1100 m) (Kornicker, 1981:72).

DISCUSSION.—The three tribes are separated mainly by appendages. Fossils, at present, cannot be identified to tribe; therefore, all are included herein in the tribe Cycloleberidini because it is the more common tribe in the Holocene.

CYCLOLEBERIDINI Hartmann, 1974

COMPOSITION.—The Cycloleberidini includes four genera: *Cycloleberis* Skogsberg, 1920; *Leuroleberis* Kornicker, 1981; *Alphaleberis* Kornicker, 1981; and *Eocypridina* Kesling and Ploch, 1960. Only the latter is interpreted to be present in the Paleozoic and Mesozoic.

DIAGNOSIS.—Same as for family.

RANGE.—Upper Devonian to Holocene.

DISCUSSION.—Because of insufficient details available in fossils, we have included Paleozoic and Mesozoic species in the genus *Eocypridina.* The three remaining genera in the tribe are recognized only in the Holocene.

Eocypridina Kesling and Ploch, 1960

TYPE SPECIES.—*Eocypridina campelli* Kesling and Ploch, 1960.

DIAGNOSIS.—Same as for subfamily.

RANGE.—Upper Devonian to Upper Jurassic. Questionably from Devonian of Russian Platform (Samoilova, 1976:150).

Eocypridina radiata (Jones and Kirkby, 1874)

FIGURES 20–22

Cypridina radiata Jones and Kirkby, 1874:14, pl. 5: fig. 6a–f.
Radiicypridina radiata (Jones and Kirkby, 1874).—Bless, 1973:250, fig. 1.
Eocypridina radiata (Jones and Kirkby, 1874).—Sohn, 1977:129.
Eocypridina aciculata (Scott and Summerson, 1943).—Sohn, 1977:132, figs. 1b,c,g,h, 2c,d,g–r.

HOLOTYPE.—*Cypridina radiata* (Jones and Kirkby, 1874).

TYPE LOCALITY.—Glasgow, Scotland.

MATERIAL.—USNM locality 9260?, Hydra, Greece 1, 21 Aug 1968?: USNM 496711, RV; USNM 496714, RV. USNM locality 9260, Hydra, Greece 1, 21 Aug 1968: USNM 496715, RV. USNM locality 9260, Greece 3, 21 Jun 1975: USNM 496716, complete carapace; USNM 496721, LV.

DISTRIBUTION.—France, Great Britain, and Greece.

DESCRIPTION.—Carapace ovoid in lateral view with slit-like or rounded oblique incisur (Figures 20*a,b,* 21*a,* 22*a,b*). Rostrum sharply acuminate and hook-like (Kesling and Ploch, 1960:284). In lateral view, posterior evenly rounded (Figures 20*a,b,* 22*a*) or with slight posterodorsal angle (Figure 22*a,d*), and without siphon. In dorsal and ventral views, carapace broadest near midlength (Figures 20*c,* 21*c*), and anterior half possibly more acuminate than posterior half (Figures 20*c,* 21*c*). In end view, carapace evenly rounded (Figures 21*b,* 22*e*). Valves almost equivalved (*Eocypridina campelli* (Kesling and Ploch, 1960)), or left valve overlaps right on complete carapaces (Figure 22*c–e*).

Ornamentation: Ridge along ventral edge of rostrum of USNM 496714 (Figure 21*a,b*), but not on other specimens (Figures 20*a,* 22*a,b*). Carapace fairly smooth (Figures 20*a,c,* 21*a,b,* 22). (A low swelling in anterodorsal quadrant of USNM 496714 (Figure 21*a,b*) is tentatively interpreted as not being a node similar to those in the Paleomyodocopina.)

Hinge: None evident (Figure 21*e*).

Infold: Not preserved (Figure 21*e,f*).

Central Adductor Muscle Scars: Consisting of numerous long slender straight or slightly curved elongate scars located near valve middle (Figure 21*a,d*).

Carapace Size (in mm): USNM 496711, RV, L=2.45, H= 1.87; USNM 496714, RV, L=1.86, H=1.44; USNM 496715, RV, L=2.12, H=1.57; USNM 496716, complete carapace, L=1.28, H=1.00; USNM 496721, LV, L=2.42, H=2.02.

RANGE.—Upper Devonian to Permian.

REMARKS.—Differences in the width and curvature of the rostrum of the Permian specimens indicate that several species may have been included in this taxon. The differences are not of sufficient distinction to separate them at this time.

The muscle scars of *Eocypridina radiata* are radiate. Shells of Permian specimens having a shape similar to that of *E. radiata,* but without evidence for having a radiate muscle scar, are tentatively referred to *E. radiata* herein.

Eocypridina sp. (Dzik, 1978), new combination

Cycloleberis sp. Dzik, 1978:393, figs. 1–3.

DIAGNOSIS.—Same as for genus.

RANGE.—Upper Jurassic, Volga Region. USSR.

REMARKS.—The unique specimen has some of its appendages preserved.

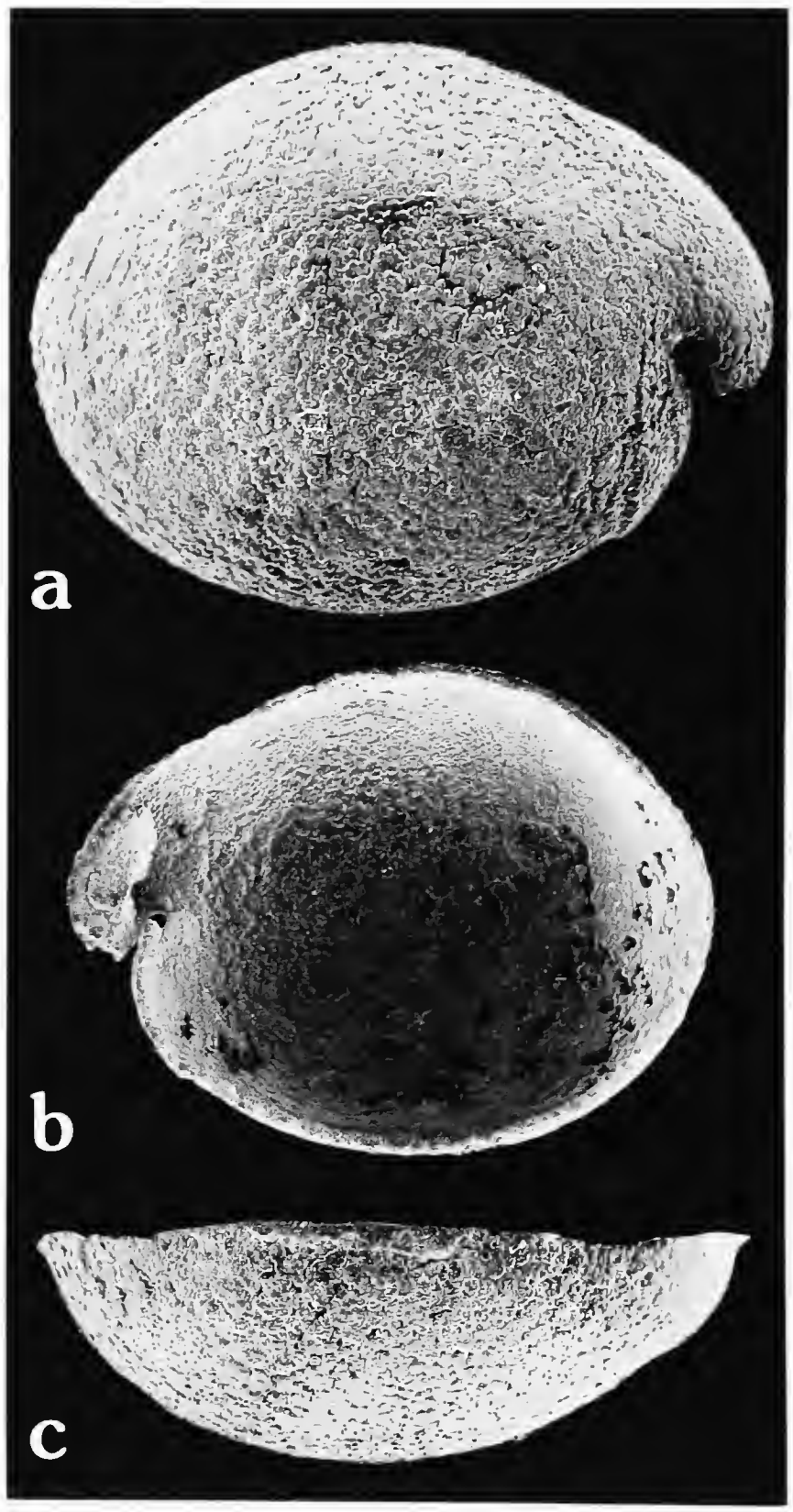

FIGURE 20.—*Eocypridina radiata* (Jones and Kirkby, 1874), USNM 496711, RV, length 2.45 mm: *a,* lv, × 45; *b,* iv, × 37; *c,* dv, × 40. (Original magnifications of micrographs reduced to 81% for publication.)

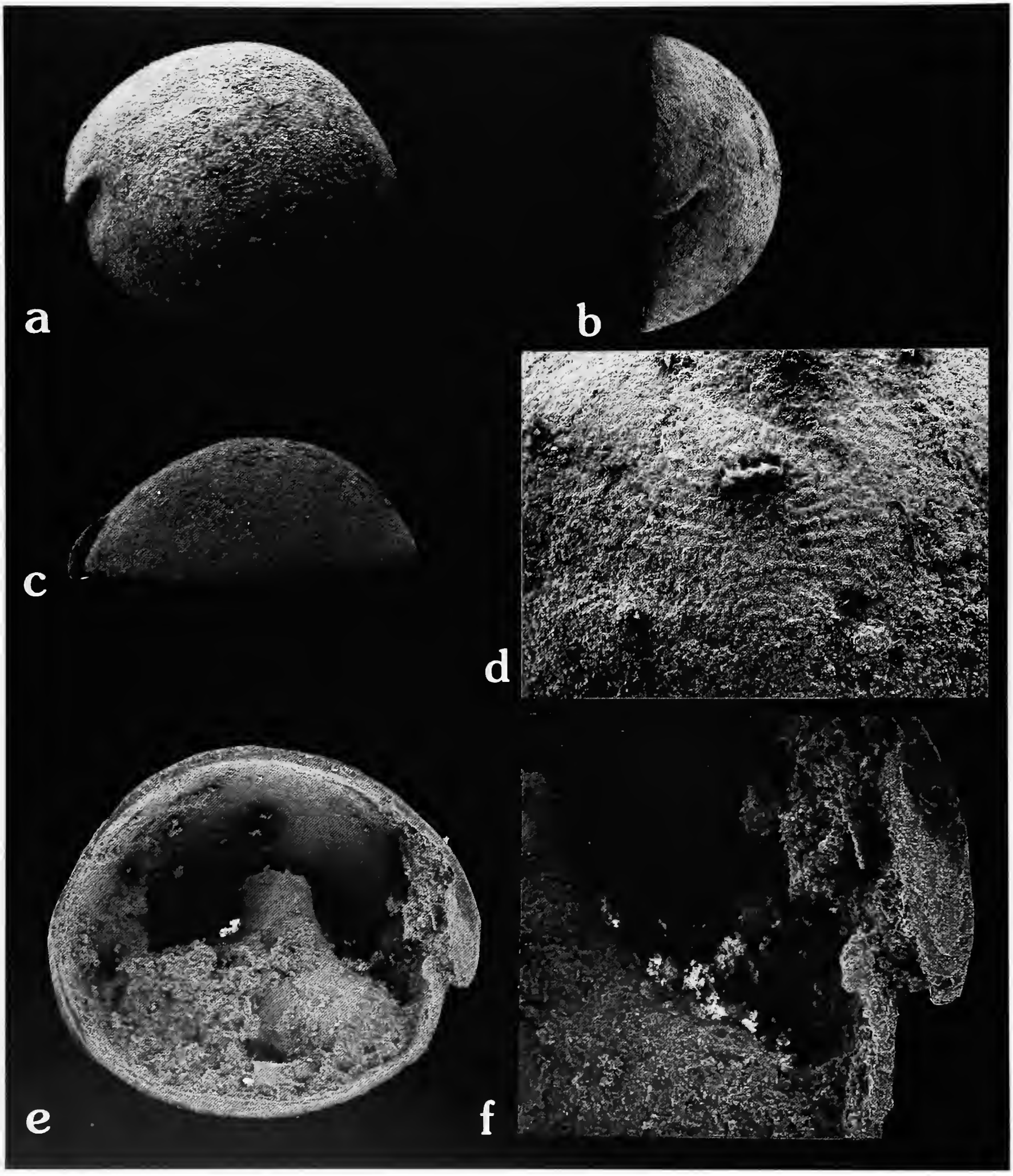

FIGURE 21.—*Eocypridina radiata* (Jones and Kirkby, 1974), USNM 496721, LV, length 2.42 mm: *a,* lv, × 26.8; *b,* av, × 26.8; *c,* vv, × 26.8; *d,* detail of central adductor muscle scars, from *a,* × 75; *e,* iv, × 31.8; *f,* detail of anterior, from *e,* iv, × 80. (Original magnifications of micrographs reduced to 95% for publication.)

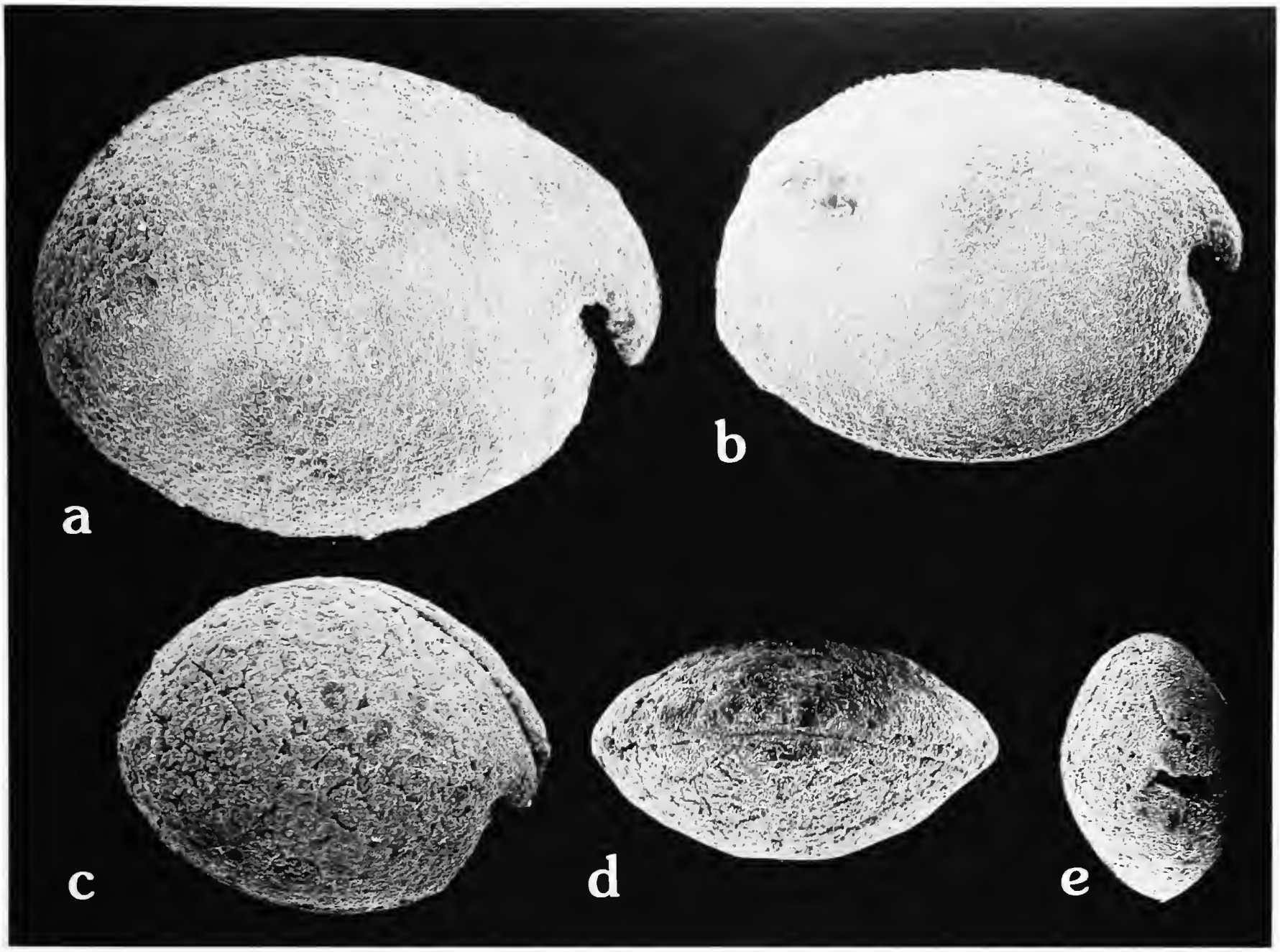

FIGURE 22.—*Eocypridina radiata* (Jones and Kirkby, 1974). USNM 496714, RV, length 1.86 mm: *a,* lv, × 52. USNM 496715, RV, length 2.12 mm: *b,* lv, × 37. USNM 496716, complete carapace, length 1.28 mm: *c,* lv, × 50; *d,* dv, × 50; *e,* av, × 50. (Original magnifications of micrographs reduced to 99% for publication.)

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